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ABSTRACT

Since the end of World War II and the onset of the "new age," nuclear technology has remained high on the world's agenda as questions regarding sovereignty and the balance of power, control of the development and spread of nuclear weapons, non-military uses for nuclear technology, and nuclear safety are debated among and within nations. The "club" of nuclear nations has grown dramatically and the number of nuclear weapons has grown from zero to over 60,000 in just over 50 years. This curriculum unit examines the development and use of nuclear technology through six main activities. Each activity allows students to explore a case study that looks at possible scenarios for the control of nuclear technology and the challenges that policy makers face with respect to nuclear technology. The unit's activities help students develop a basic understanding and issues of nuclear technology. The unit's goal's are to review the history of the development and spread of nuclear technology; familiarize students with treaties and agreements regarding nuclear technology; consider options for controlling nuclear technology; and make connections between the students' own experiences with nuclear issues and the presentations in the unit. Following preparatory activities, the six activities are: (1) "supranational organizations"; (2) "nation-states"; (3) "everyone"; (4) "physicists/scientists"; (5) "business and nuclear industry"; and (6) "no one." A closing activity, six appendixes, and bibliography and resources conclude the unit. (BT)

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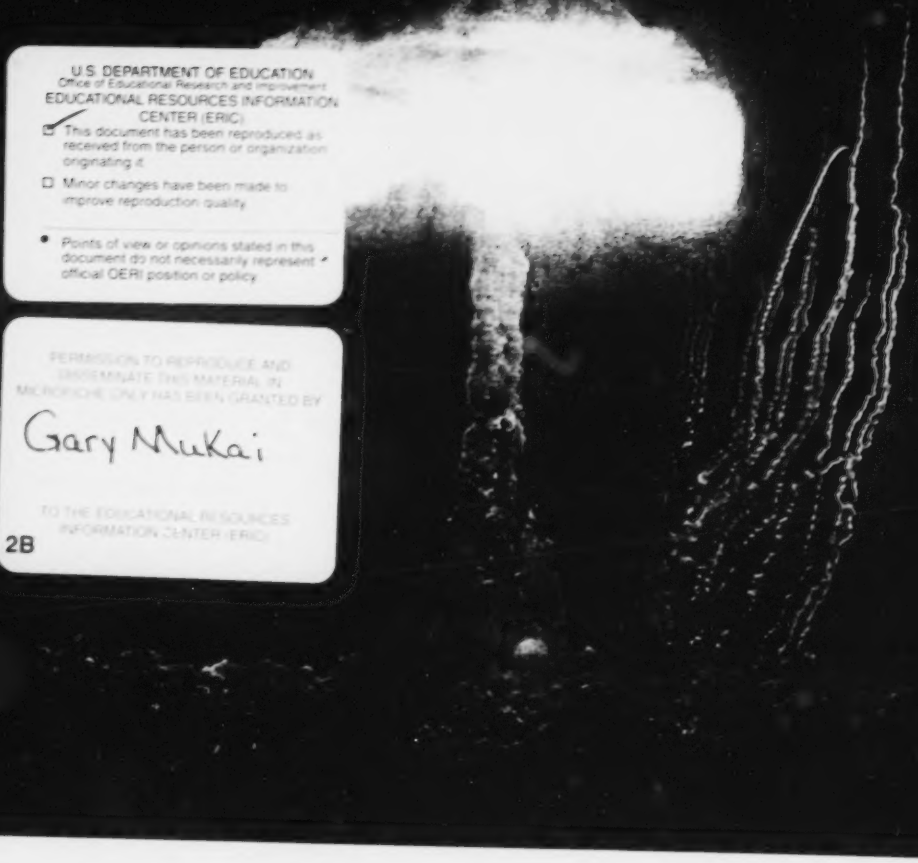

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WHO SHOULD CONTROL NUCLEAR TECHNOLOGY?

A Curriculum Unit for Contemporary U.S. and World History
Grades 9-12

Developed by Michelle Zimney
Stanford Program on International and Cross-cultural Education (SPICE)
Institute for International Studies

in cooperation with the

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Unit Introduction

WHO SHOULD CONTROL NUCLEAR TECHNOLOGY?

Rationale

From the very beginning, the development and use of nuclear technology raised new, difficult issues for scientists and policy makers. Many people close to the Manhattan Project were concerned with the fate of nuclear technology both during and beyond World War II. The successful "Trinity" test explosion in July 1945 caused physicists and presidential advisors alike to appeal to the president for restraint in using the bomb. They explained that U.S. interests would be well served by disclosure of our atomic potential and an effort to reach an international agreement on the new technology. Nevertheless, two atomic bombs were dropped on Japanese cities in 1945, demonstrating to the world the power of these weapons and opening the nuclear age.

Since the onset of this new age, nuclear technology has remained high on the world's agenda as questions regarding sovereignty and the balance of power, control of the development and spread of nuclear weapons, non-military uses for nuclear technology (e.g., energy, medicine), and nuclear safety are debated among and within nations. The "club" of nuclear nations has grown dramatically and the number of nuclear weapons alone has grown from zero to over 60,000 in just over 50 years. Nuclear technology advocates argue that nuclear power plants provide badly needed energy and prevent the devastation of nonrenewable resources. Nuclear opponents believe that nuclear accidents and contamination such as that resulting from the Chernobyl disaster are inevitable and make nuclear energy an undesirable energy option. Arguments on moral as well as political grounds swirl around the issue of the development, maintenance, and use of nuclear weapons.

At the heart of many of the debates lies the fundamental question, "Who should control nuclear technology?" French testing of atomic weapons in the Pacific in 1995 and 1996, the potential development of nuclear weapons by Iraq, and the effects of the dissolution of the Soviet Union on internal safety controls remind us that this question has no simple answer. Some advocate that the use and development of nuclear technology by them alone or a select few is essential to international security, while others believe nuclear weapons are such a profound threat to the planet that no one should have access to them or the technology that makes them possible.

Who Should Control Nuclear Technology? looks at some of the questions about the development and use of nuclear technology through six main activities. Each activity allows students to explore a case study that looks at possible scenarios for the control of nuclear technology. Students grapple with some of the challenges that policy makers often face with respect to nuclear technology. Through the orientation activity and the

six focused activities, students will develop an elementary understanding of nuclear technology and the issues it raises for the world. The resources for this unit were chosen because they illustrate significant points and provide an array of perspectives on the topic. We encourage teachers to add current examples and additional perspectives when possible to ensure even-handed treatment of this complex set of issues.

Who Should Control Nuclear Technology? offers an introduction to a complex and sometimes contentious subject. It does not attempt to provide illustrations of all elements related to the development and use of nuclear technology nor does it attempt to explore all the relevant questions. The cases do offer students an opportunity to consider a wide range of problems. In each activity, students will explore the pros and cons of different scenarios for the control and management of nuclear weapons and technology, while they learn about the challenges of policy making.

Unit Goals

- to review the history of the development and spread of nuclear technology
- to familiarize students with significant treaties and agreements regarding nuclear technology, including the NPT
- to consider options for controlling nuclear technology
- to make connections between the students' own experiences with nuclear issues and the presentations in the unit

Unit Framework

This unit is designed primarily for teachers teaching contemporary world issues, world history, or U.S. history. These activities might also be used as part of more extensive studies of the last half of the 20th century and of issues related to nuclear technology.

Group Work

The pedagogical design of *Who Should Control Nuclear Technology?* is based on many years of research in the Stanford School of Education by Dr. Elizabeth Cohen, and more recently Dr. Rachel Lotan, on how to increase student access to learning through group work. This research by The Program for Complex Instruction led to the development of a teaching approach and a model for curriculum materials. The teaching approach itself is a complex one and involves intensive staff development for full implementation. These materials are not designed to introduce that approach to the novice. They do, however, fit the model for curriculum materials and may be useful to teachers using the complex instruction approach. It is our hope that material developed in this way will also be useful to teachers using other cooperative, small group teaching strategies.

Group work curriculum units contain 6 to 8 activities organized around a big idea, central question, or major concept of a discipline. Students rotate through a series of group activities designed to stimulate thinking and discussion about the big idea. When students report the results of their investigations, the teacher needs to ask questions that probe the students' understanding, make connections among the different activities, and address the fundamental content of the unit.

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At the heart of these curriculum materials are resource materials which draw heavily on primary sources and provide students with greater access to the academic content of the unit. When students examine photographs or listen to tapes in addition to reading textual material, they have increased access to the learning task. Even students who cannot read at grade level will participate more.

Each activity includes a group project that is multidimensional and encourages the use of multimedia. These projects give more students the opportunity to contribute to the success of the group and to demonstrate and be recognized for their own competence and understanding of the content. Increased participation is related to increased learning. These materials combine a group project which reinforces the students' interdependence and an individual report which holds students individually accountable.

An important feature of this curriculum model is the open-ended nature of the questions. Most questions do not have one right or wrong answer and the group products also depend on the group's decision. This design feature contributes to the development of higher-order thinking skills.

In *Who Should Control Nuclear Technology?*, students explore the title's complex question. Students begin with a *Skill Builder Activity* that introduces them to the concept of negotiation and its processes through a "Cooperative Security" game. This is followed by an *Orientation Activity* in which they are introduced to the history of nuclear technology, from the discovery of fission to the various applications of this technology and the resulting world events.

At the core of the unit are six activities that specifically address the central question by focusing on six different scenarios for controlling nuclear technology. Each activity includes a section for the teacher with background information. Also included are extension questions to assist the teacher in debriefing student presentations and a list of related issues to serve as further research or discussion items. Each activity also includes a set of cards for the students: an *Activity Card*, which includes background information, open-ended questions, and an interdependent task the group must complete; a set of *Resource Cards*, which are needed to complete the task; and an *Individual Report*, which serves to reinforce individual, as well as group, accountability and to give the teacher a measure of the student's understanding of the big idea.

At the end of the unit is the *Closing Activity* in which students will demonstrate their understanding of the issues related to the control of nuclear technology by preparing for, and participating in, a simulated treaty conference.

Multiple Abilities

In order to ensure access to learning, multiple-ability tasks are incorporated in each of the activities. The following is a list of some of the multiple abilities that the students will need to complete the various activities in this unit:

Linguistic abilities

- understanding how a text fits into the big picture
- translating the message of the text into another form
- identifying the main point of the text
- identifying multiple points of view

- explaining ideas clearly

Visual abilities

- grasping the message of a picture
- recognizing and using symbols
- noting details in pictures
- interpreting political cartoons
- translating ideas into visual forms
- interpreting graphs and charts

Spatial abilities

- interpreting schematic plans
- translating ideas into layouts and schematic designs
- translating ideas into three-dimensional models

Interpersonal abilities

- listening to and interpreting the ideas of others
- clarifying perspectives and points of view
- asking for help when needed
- recognizing when help is needed by others and providing appropriate assistance
- sharing resources and tools with others
- working with others to complete a task

Dramatic abilities

- creating a dramatic sequence
- expressing feelings, messages, and situations through acting

Reference

Cohen, Elizabeth G. *Designing Groupwork: Strategies for the Heterogeneous Classroom.* New York: Teachers College Press, 1994 (rev. ed.).

Icons

For easier reference the following icons are used throughout the unit:

Group Work

Background Information

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PREPARING FOR GROUP ACTIVITIES

Structure

The Complex Instruction model is based on the idea that true understanding of a concept comes only through working with that concept repeatedly. Ideally each group should have the opportunity to experience each activity—in this case the students go through six "rounds." At least two or three rounds of activities are recommended. The chart below demonstrates how all the groups could experience six rounds.

Group A	Group B	Group C	Group D	Group E	Group F
Activity 1	Activity 2	Activity 3	Activity 4	Activity 5	Activity 6
Activity 2	Activity 3	Activity 4	Activity 5	Activity 6	Activity 1
Activity 3	Activity 4	Activity 5	Activity 6	Activity 1	Activity 2
Activity 4	Activity 5	Activity 6	Activity 1	Activity 2	Activity 3
Activity 5	Activity 6	Activity 1	Activity 2	Activity 3	Activity 4
Activity 6	Activity 1	Activity 2	Activity 3	Activity 4	Activity 5

Roles

Many teachers find that assigning roles to each member of the group encourages full participation. The following roles have been found effective:

- **Facilitator**: makes sure everyone understands the instructions; ensures that all the group members participate; calls the teacher if no one in the group knows the answer; and makes sure that all members of the group get the help they need.
- **Recorder**: makes sure group has notes from the discussion; and ensures everyone completes an individual report.
- **Materials Manager**: collects whatever materials are needed to complete the task.
- **Harmonizer**: makes sure communication lines are open; and makes sure there are no "put -downs."
- **Reporter**: organizes the group's report to the class; discusses with the group what will be reported; and summarizes the activity to introduce the report to the class.

unit preparation

Sequence and Suggested Time for Activities

The sequence of activities in this unit and the suggested time for each are as follows:

ACTIVITY	SUGGESTED TIME
Skill Builder Activity	1-2 class periods
Orientation Activity	1-2 class periods
Activities 1 through 6	1 activity per class period
•Group work (reading the cards and answering the questions)	30 minutes
•Preparing presentation	10 minutes
•Presentations	10 minutes per group
Closing Activity	3 class periods

Materials and Equipment

- Butcher paper
- Strips of colored paper
- World map (laminated if possible)
- Card stock
- Felt-tip pens
- Old magazines, yarn, and other scrap materials (alternative: modeling clay)

Teacher Preparation

1. Each activity includes a set of cards for the students. We encourage you to print these on heavy stock paper and on different colors. For example, the Activity Cards might be green and the Resource Cards white. It is advisable to laminate the Activity and Resource Cards so that they can be reused. Another option is to insert them in plastic sleeves.
2. If the classroom equipment allows, each group should have their own table. The cards and any equipment that students will need should be on each table before they get started.
3. Maintain a section of the classroom with materials for the students to complete their group tasks. This section should be designated so that the Materials Managers know where they can go to obtain supplies for their group.
4. Use a stopwatch or a simple kitchen timer to keep track of time for each segment of the activity.

Optional Activities

- If possible, videotape, record, or photograph the various groups' performances and presentations.
- Have newsprint available for students to record any questions or comments they may have about nuclear technology and its uses.

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Skill Builder Activity

COOPERATIVE SECURITY – A SIMULATION

Overview

The purpose of this *Skill Builder Activity* is to acquaint students with the concept of negotiation and to give them direct experience with its processes. The simulation requires students to negotiate the use of a field shared by two farmers. The structure of the simulation parallels disarmament negotiations and should help students relate more easily to the issues and processes that they will study later in this unit. The simulation is debriefed through a series of questions that will address issues such as mutual trust, the difference between collective and individual gains, costs and benefits, and links to real-world issues such as the dynamics surrounding the nuclear arms race.

Objectives

- To introduce students to the concepts of negotiation and cooperative security
- To provide students with an experiential base upon which to build future understanding of the negotiations surrounding the development and use of nuclear technology
- To develop students' analytical and problem-solving skills

Time

One or two class periods

Materials

- Identity Cards (one per team)
- Handout 1, Farming Game Scenario (one per student)
- Handout 2, Scoring the Standard of Living (one per team)
- Handout 3, Team Planning Sheets (one per team)
- Teacher Play Cards
- Pens or pencils

Teacher Background

This activity pairs small teams of students to negotiate with one another to determine how shared land will be used. Each team represents a farmer who must choose a method for plowing the field. The horse and plow will do the job well enough to provide for the farmer's family, but leaves him/her vulnerable if the other farmer uses a tractor. The latter will be able to plow a greater portion of the shared field, thereby increasing his/her standard of living at the expense of the former. This dilemma is intended to simulate the tension a nation-state experiences when deciding whether to disarm or to maintain an armed position.

Each team will be given an Identity Card with an identity that roughly parallels one of the common negotiating positions of a nation-

state regarding nuclear technology and arms. These identities help define the farmers' priorities in making plowing choices and create match-ups similar to those encountered in international negotiations. For instance, a "traditionalist," in choosing the horse and plow, will generally earn a lower standard of living than a "first on the farm" negotiator.

As the simulation continues through several rounds, students will begin to understand the process and difficulties associated with negotiation. Much depends upon having a clear position and articulating it effectively. They must learn to deal with uncertainty about the goals and motives of the other farmer. Students will also learn the importance of careful attention to both rhetoric and action in determining the character of a negotiating party.

Teacher Play Cards are included to simulate various inequities in surveillance capabilities, levels of technology and power relative to one another. The teacher should hand the cards to players throughout the game, just before a new round is beginning. The information is intended to remain secret until that round is completed. The facilitator of the simulation should return to the negotiating parties at the end of the round to verify that the instructions were followed. It is recommended that these cards be used sparingly.

Introduce the simulation the day before it begins to give students an opportunity to review the scenario and their Identity Cards before actual play begins. During the simulation itself, there should be time for 6 to 8 three-minute rounds. It is important to keep the negotiations fast-moving to simulate the pressure to make rapid decisions that is often inherent in international negotiations.

Questions for debriefing the activity are included at the end of the Suggested Procedure below. It is important to allow adequate time for debriefing the activity at the end of the period. For general background on using simulations in the classroom, refer to the Teacher Information sheet "About Simulations."

Suggested Procedure

1. Divide students into teams of 2 to 4 students. Pair each team with another team.
2. Distribute Handout 1, Farming Game Scenario, to each student. Allow students to ask clarifying questions, but be sure to leave the situation sufficiently ambiguous to allow them to bring their own thinking and experience to the activity.
3. Distribute the Identity Cards to the teams. Remind them to keep the information confidential until the game is over. Tell them that this identity will help shape their negotiating stance with the other team. Tell them that they will keep this identity until the end of the game and must remain true to its characteristics as they make decisions.
4. Explain that there will be several rounds of the simulation, allowing time for several "years" to pass. Remind the teams that each farmer is allowed to use a tractor only five times before it breaks down and then he/she must return to the use of a horse and plow for a year.
5. Decision phase: To begin the game, each team should determine and record on their Team Planning Sheet their plowing decision for the first "year" of the simulation. (There is no negotiation before the first round.)

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6. Scoring phase: Once teams have made their decision, they should meet with the "farmer" with whom they have been paired and compare their decisions. They should then use the chart on Handout 2 to determine each farmer's standard of living for the year. These should then be recorded on the Team Planning Sheet. This concludes Round One of the simulation.

7. Negotiation phase: To begin Round Two, allow the student teams to negotiate with each other to determine what will happen the second year. They may wish to develop treaties, make verbal agreements, etc. However, they may still disagree at the completion of the negotiating period. As a facilitator, monitor the negotiations to ensure student safety, but do not suggest strategies or ideas to them. As you observe their negotiations, you may want to take notes to aid in the debriefing period.

8. Repeat steps 5, 6, and 7 for several more rounds (6 to 8 are desirable). It is important for the students to experience a number of rounds in order to develop the relationship between farmers and for the effects of certain decision patterns to be fully realized (i.e., the costs of repeated use of the tractor or repeated betrayal of an agreed-upon position).

9. As a facilitator, occasionally use your access to all groups to add unexpected dynamics into the negotiations.

   As you move about the classroom, note "spy" information to pass on to a "farmer" on a Teacher Play Card. This simulates the kind of unfair advantage that may result from real-life high-tech surveillance systems.

   You may also use a Teacher Play Card to encourage a "Big-Time Farmer" to make an offer to a team that they will be ensured a high standard of living if they use a horse and plow for the next round. In return, the farmer must cross off two of his/her tractor turns at the bottom of the Team Planning Sheet. This simulates guaranteed short-term rewards in lieu of resources that in the long-term might allow them to provide for themselves. This roughly simulates the dynamic created when nuclear nations provide security for those who agree to forgo nuclear weapons development.

   You may use another Teacher Play Card to give one farmer a technological advance by slipping an "Early Plow Technology" card to a team just before the beginning of a negotiations round. This will allow them to claim 20% more of the field than their plowing decision would have earned them that year. Accordingly, their standard of living will be one step higher (and the other team's one step lower) than they expected.

   Templates for Teacher Play Cards are provided at the bottom of the Identity Cards handout.

10. After the final round, each "farmer" should record the final year's outcome and average their general standard of living over the course of the game. This will be helpful in assessing the effectiveness of decisions and negotiating strategies.

Debriefing

Following is a suggested sequence of questions for the debriefing. It is recommended that you augment this with additional questions that link the students' experiences to your ongoing study in class.

- How are you feeling about this simulation? How do you feel about the final outcome for your "farmer"? Did your feelings change as the simulation progressed? In what ways?
- How do you feel about your own farmer team? How do you feel about the farmer team who shared your field?
- Describe the game. Who did the negotiating? What factors did your farmer need to consider? Which factors were more/less important?
- What was your farmer's goal? What motivated you as farmers to act the way you did? (Possible answers may include a desire for peace, fear, greed, need for security, ignorance.)
- What strategies did you use in the game? Are there additional strategies you might have tried? What would you do differently if you participated in the simulation again?
- How did the identity assigned to your farmer affect your decisions? Would you have played the game differently if you had not been constrained by that identity? How?
- Were there any disagreements within your farmer team about what to do in the game? If so, how were they resolved?
- How would the game be different if you knew exactly what the other farmer team was going to do? In what other ways might you have gained an advantage in the game?
- In what ways did you receive benefits as an *individual* farmer? In what ways did *both* farmers gain together? Were your actions geared more toward individual gain or common good? Why do you think this is the case?
- What similarities do you see between the simulation and real life? What might the following features represent in countries' relations with each other and nuclear weapons negotiations?
  - * farmers
  - * the field
  - * the harvest
  - * tractor vs. horse and plow
  - * "early plow" card
  - * big-time farmer
  - * negotiations rounds
  - * identity cards
  - * secrecy about identities and teacher play cards
- How is the simulation different from real life? (Answers may include that farmers are equally powerful, but not so in real life; the stakes: no one dies in the simulation; players can easily alternate between tractor and horse, but not so with nuclear weapons; the identities in the game are intended to be straightforward while real-life national identities are much more complex.)

Reference

Colman, Andrew M. *Game Theory and Experimental Games.* Oxford: Pergamon Press, 1982, pp. 101-104.

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TEACHER INFORMATION: ABOUT SIMULATIONS

A simulation is an important learning activity which involves students in roles where they must think and act in a situation which is similar to one in real life. Although never able to duplicate the complexity of a real event or teach specific facts, a simulation may allow students to exercise some of the problem-solving skills and experience some of the feelings which occur in a real event. A simulation should never be treated lightly as "only a game." Good simulations have the capacity to generate very strong thoughts and feelings in their participants, and the teacher always should be prepared for that possibility.

Although simulations involve role play, they operate within the constraints of a pre-designed set of rules. A certain degree of ambiguity in these rules leaves room for students to bring their prior experience and personal values to the activity, but the general framework is defined. Careful thought should be given to the organization of a simulation in a unit of instruction. How can the simulation be structured to allow adequate time for orientation, play, debriefing, and follow-up? Is the available physical space adequate?

A simulation is run most successfully when participants have had a clear, concise introduction to its framework. As rules and roles are explained, time should be allowed for questions and practice. It is important, however, that the focus remain on the framework of the activity. The facilitator should avoid comments or answers that suggest strategies or infer outcomes.

During the simulation, the facilitator should carefully observe the proceedings and take notes which may help guide the debriefing. It is important to remember that the students will sometimes select strategies that don't work and communications may sometimes become tense and difficult. Unless the participants' safety is jeopardized, the facilitator should not coach or intervene in the interaction, but allow students the opportunity to solve problems directly.

Debriefing a simulation is essential. Unless there is adequate time for debriefing, a simulation should not be attempted. A missing or inadequate debriefing may leave a residue of misunderstandings and/or misinformation which may have negative consequences both in and outside the classroom. Equally important is the lost opportunity for reflection and learning. Traditional evaluation methods generally are not appropriate for simulations. Many teachers

have found an effective evaluation activity to be a journal entry or other writing exercise in which students summarize their insights from the activity and its debriefing. Others may use a simulation as a form of performance assessment.

Simulations are often noisy and sometimes confusing. They require considerable flexibility. Yet, their potential for developing deepened understandings of key concepts and increased skill in decision making, communication, negotiation, and conflict management remains high, making them an important learning tool.

Role of the Teacher

The role of the teacher/facilitator is very important. He/she first must set the context for the simulation and ensure that participants understand the rules. Once the simulation begins, he/she becomes the monitor and timekeeper, making sure that the negotiation rounds take place on schedule. The facilitator should avoid making decisions for the players when questions arise during the actual simulation. The facilitator's most important role takes place during the debriefing session after the simulation, when he/she guides students' reflection and discussion about the experience. If more than one facilitator is used, responsibilities should be divided before the simulation begins.

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IDENTITY CARDS AND TEACHER PLAY CARDS

IDENTITY CARD

FIRST ON THE FARM

You and your family have been on this land for generations. Your first priority is to provide for your family as well as you have in the past. You don't like having to share this field and feel the tractor has always done well for you. You tend to use your seniority over others and strongly dislike compromises!

IDENTITY CARD

TRADITIONALIST

You understand modern technology is upon you, but have always done just fine with your horse and plow. It's reliable, inexpensive and in tune with your personality. Tractors may be fine for others, but you'd like to stick with your horse and plow if you can.

IDENTITY CARD

FRIENDLY FRANCIS

You are a farmer because your land was left to you by relatives. Wealth is not particularly important to you. Your priority is to maintain good relations with the other farmer. You value that friendship and do whatever you can to keep it.

TEACHER PLAY CARD

SPY INFORMATION

Our spy network has just let us know that the other farmer will be choosing _____ as his/her method of plowing next year.

IDENTITY CARD

STRAIGHT TALKER

You value honesty and integrity greatly. When you negotiate, you try to be fair and then stick by your word no matter what. You figure it's better to let someone know what you really think than to lie and switch behind their back. You expect others to do the same.

TEACHER PLAY CARD

BIG-TIME FARMER OFFER

You are hereby guaranteed a standard of living at level A if you agree to use your horse and plow for this round. In return, you must cross off two tractor turns on your team planning sheet and let the other team know at the end of the round.

IDENTITY CARD

NEW IN TOWN

You are new in town and not sure if you can trust people yet. You've worked hard to earn your high standard of living and plan to keep it that way. You don't particularly care what others think of you as long as you get what you deserve.

TEACHER PLAY CARD

EARLY PLOW TECHNOLOGY

You are being given new secret technology that allows you to start plowing early. This will allow you to plow 20% more field than you usually would. It is good for one round.

FARMING GAME SCENARIO
HANDOUT (1 OF 3)

You are a farmer who shares a field with another farmer to grow crops that support you and your family's livelihood. Everything you are able to buy including food, heat, furniture, clothing, cars, televisions and vacations is dependent on how good your harvest is in a given year.

On the first day of each growing season (you live in a temperate climate where the ground is completely frozen for part of the year), you both pull out your tractors and begin plowing the field as quickly as possible. Together, you have agreed that whoever plows a section of the field first "owns" it for the year and can plant and harvest it. Since you both own the same type of tractor, and plow at the same speed, the field gets divided 50-50 every year. This gives you a standard of living at level C (see chart on Handout 2).

One thing to keep in mind is that tractors can be expensive and tend to break down every once in a while. This will happen after five years of using it and you will need to send it to the shop for a year. During the year it is being fixed, you must use a horse and plow on the field. To help solve this annoying problem, you've come up with an idea to propose to the other farmer. You would like to start using a horse and plow instead of tractors on the field. If both of you use the horse and plow method, you'll still be able to plow at the same speed as one another and the field will be divided 50-50. In addition, the maintenance costs for this method are much lower, which leaves both of you more money to spend on luxuries for yourselves. Your standard of living for the year will be at level B.

Of course there is a catch. If only one of you actually uses the horse and the other uses a tractor, the field will be plowed much more quickly by the tractor and that farmer will get 80% of it for planting that year. With such a huge harvest, he/she will be able to live at level A. On the other hand, the farmer that used the horse will only have 20% of the land and will only be able to afford life at level D.

What will you do?

SCORING THE STANDARD OF LIVING HANDOUT (2 OF 3)

Depending on your decision, there are several possible standards of living you and the other farmer might achieve. Following is a summary of the possibilities for your standard of living.

If you:	Your standard of living will be:
use tractor, other uses horse	Level A
both use horses	Level B
both use tractors	Level C
use horse, other uses tractor	Level D

Another way to look at it is:

		Other Farmer: Horse	Other Farmer: Tractor
You	Horse	B, B	D, A
	Tractor	A, D	C, C

NOTE: Horse and Tractor are the plowing choices of each team. The score is read by following your choice across and the other farmer's down until you meet in a box. The score is read as: your level, other farmer's level. For example, if you chose Horse and the other farmer chose Tractor, your score is in the upper right-hand box (D,A). Your level is D, while the other farmer's is A.

Standards of Living

Level D: You can only afford food and shelter. You make your own clothes, have no electricity, and hand-pump your water.

Level C: You have the basics of level D plus running water, electricity, a black-and-white television and a bike.

Level B: You can afford everything at level C plus a stereo and CDs, color television with cable, concert tickets, and a scooter.

Level A: You can afford everything in level B plus a computer with games, two cars, and luxury vacations. You can also hire someone to do all your farming for the year.

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TEAM PLANNING SHEET
HANDOUT (3 OF 3)

Year	Plowing Decision (Horse or Tractor)	Standard of Living (A/B/C/D)
1		
2		
3		
4		
5		
6		
7		
8		
Average		

NOTE: When averaging your standard of living at the end of the game, use these values:
A=10, B=7, C=4, D=2.

Number of tractor uses: 1 2 3 4 5

(After five uses of the tractor, your tractor breaks down and you must use a horse and plow the next year.)

Orientation Activity

NUCLEAR HISTORY

Overview

The purpose of this *Orientation Activity* is to provide students with an introduction to nuclear history, from the discovery of fission and its development in the Manhattan Project through various applications of the technology. It provides an overview/review of major world events that have been caused or shaped by the use or development of nuclear weapons. This basic historical background will be useful in addressing the organizing question of this unit, "Who should control nuclear technology?"

Objectives

- To provide students with an orientation to the history of the development and use of nuclear technology
- To identify dates and events significant in the "nuclear age"
- To develop students' experience in constructing and using timelines

Time

Two 50-minute periods

Materials

- Reporter Instruction Cards and Resource Cards for each group
- Butcher paper for a master timeline
- Notebook paper for timeline cards
- Markers and tape
- Optional: props and a video camera

Teacher Background

This introductory activity presents major elements of nuclear history in a format imitating a CNN news broadcast. To prepare for this activity, you will need to duplicate the Reporter Instruction Cards and Resource Cards for each team. You may also want to consider arranging to have the presentations videotaped. If possible, you may want to find a microphone and other "props" for the news broadcast. You will also need to prepare space on a wall or blackboard for a timeline. As student groups present their events, they will tape timeline cards to the wall according to the date in which the events occurred or were reported. Spacing for years should already be included on the timeline. Appendices B and C provide timelines of when nations have acquired nuclear weapons and when major treaties have been signed, respectively. Students will be able to refer to their completed timeline in later lessons.

It is important to keep in mind that this activity will not provide a comprehensive treatment of the history of the development and application of nuclear technology. The intent is to provide an overview of the topic.

Suggested Procedure

DAY ONE

1. Begin the first day by assuming the role of a news director for CNN. Tell the students that you are going to develop a news special reporting on the number of nuclear weapons currently in the world's arsenals. You will be dealing with the question "How did nuclear weapons grow from zero to 60,000 in fifty years?" Tell the students that they are reporters/research teams assigned to this project. Explain that the class will need to research some of the history of nuclear weapons, the principles of nuclear reactions, and major events of the atomic age. Divide students into the following three news teams:

   The Manhattan Project—fission, project mission, key people and project organization, and the "Trinity" test explosion.

   Applications—reactors (how they work), reactors (where and when), reactor accidents, and medical uses (cancer radiation therapy).

   World Events—Hiroshima, the Cuban Missile Crisis, Cold War rhetoric, North Korea and the NPT signing.

2. Have each reporter team read their Reporter Instruction Card (1a, 2a or 3a) and organize themselves to do the research. They will focus on presenting 4-5 events within the framework of a "CNN News Broadcast." Their presentation will be in the form of a report, interview, or reenactment. They must assign roles within their group and write a script for their presentation. Tell the students that they should arrange their presentation chronologically and that it should not take more than 10 minutes. They will also need to create a timeline card for each event that is covered in their broadcast.

3. Students will need enough time to study their Resource Cards, prepare their report, rehearse, and make a timeline card for their event. Encourage students to be creative as they develop their presentations and create or find interesting props/costumes. This will take the remainder of the first day. They will need to be ready to give their presentations at the beginning of the second day.

DAY TWO

4. Allow students 5 minutes for rehearsal/set-up before the news broadcast begins. Then assume the role as the CNN anchorperson introducing a story about nuclear weapons and their history to your viewers. Refer to the timeline on the wall and tell the audience that you are going to explore the development and spread of nuclear technology over the past 50+ years.

5. Introduce in sequence the news team for each theme, beginning with the Manhattan Project. As each news team concludes their report, add their timeline cards to the master timeline. Monitor the news reports to make sure that each group does not exceed 10 minutes for its presentation. Each theme group is responsible for having organized its reports in chronological order.

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6. Complete the activity by assigning students a short essay that answers the question "How did nuclear weapons grow from zero to 60,000 in fifty years?" Also distribute the Key Words Handout (4a) and ask students to complete definitions for each vocabulary word. An answer key is provided in Handout 4b.

Reference

Stoff, Michael B., Jonathan F. Fanton, and R. Hal Williams, eds. *The Manhattan Project: A Documentary Introduction to the Atomic Age*. Philadelphia: Temple University Press, 1991.

REPORTER INSTRUCTION CARD
THE MANHATTAN PROJECT
HANDOUT (1a OF 4)

As a group, you will be presenting a news report on four topics important to the Manhattan Project. Your report should address the following questions: 1) What is fission?, 2) What is the Manhattan Project?, 3) Who was in the Manhattan Project and where was it located?, and 4) What was the Trinity test explosion?

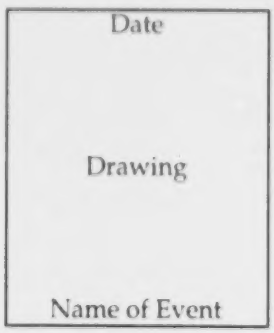
Your group has been given one resource card for each topic. Your report can be in the form of a skit, an interview, an eyewitness account, or a reenactment. Be sure to include as much factual information about the topic as you can. You will have a total of 10 minutes for your team's news report.

Here are some things to think about:

- Try to include the basics of any good presentation: Who? What? Where? and When? You may also want to provide commentary or opinions on "Why?"
- Think about what people and information you would like to include in the report. Make a list of specific points to include.
- Give characters and reporters names. Make props or costumes if you have time.
- Write out what you will be saying before the presentation.
- Create an interesting, believable, and accurate report for your part of the CNN broadcast.
- When you are making your presentation, really act your part. The more you put into it, the more interesting and memorable it will be.

As a group, determine the order of the events you'll be presenting and assign roles to each team member. Everyone should be involved in the report on at least one of the topics, but feel free to reuse people if you need to have more characters than there are team members.

Finally, before you "go on the air," you need to have a timeline card ready for each event you present. The card will be placed on the timeline on the wall and include 1) the name of the event, 2) the date or dates on which it occurred, and 3) a drawing or symbol that represents what it's all about. Use 8-1/2 x 11" paper for your timeline card.



Have fun!

RESOURCE CARD
THE MANHATTAN PROJECT: FISSION
HANDOUT (1b OF 4)

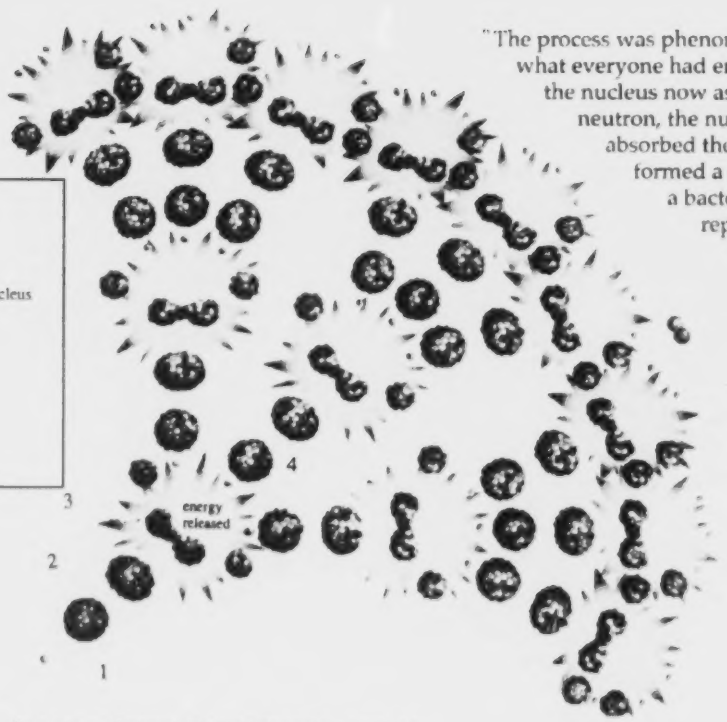
Nuclear fission chain reaction

1 Fast-moving neutron collides with uranium 235 nucleus

2 Unstable uranium 236 nucleus forms

3 Uranium 236 splits

4 Three neutrons released which collide with three more uranium 235 nuclei

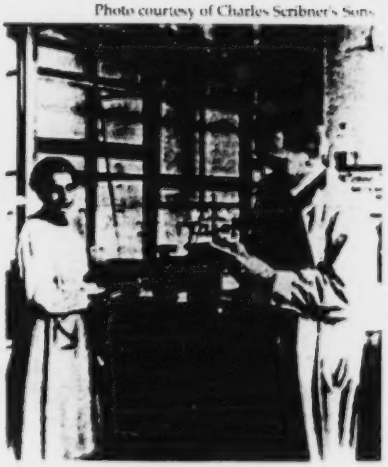


Ronan, *Science Explained: The World of Science in Everyday Life*. © 1993 by Marshall Editions Ltd. Reprinted by permission of Henry Holt and Company, Inc.

"The process was phenomenally different from what everyone had envisioned. Meitner saw the nucleus now as a droplet. When hit by a neutron, the nucleus had not shattered or absorbed the neutron. It had elongated, formed a 'waist,' and then split like a bacterium doubling in its reproductive cycle. Borrowing a term from biology, the atom had *fissioned*."

— Malcolm C. MacPherson, *Time Bomb*

Photo courtesy of Charles Scribner's Sons



Lise Meitner and Otto Hahn, shown in their lab, were two scientists who worked to discover the mysteries of fission. Their work created the possibility of nuclear energy and nuclear bombs. Soon after their discovery, they co-authored a scholarly article announcing their findings, which was published in the physics journal *Nature* in February 1939.

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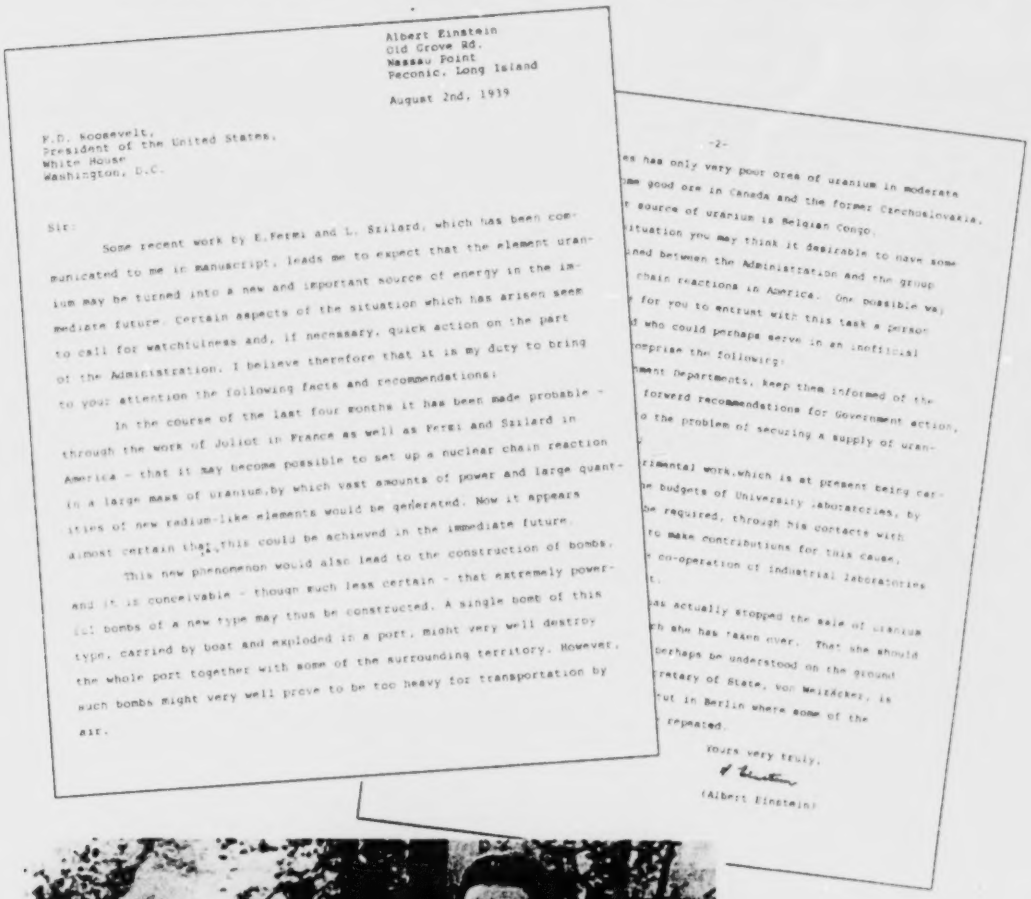
RESOURCE CARD
THE MANHATTAN PROJECT: PROJECT MISSION
HANDOUT (1c OF 4)

"In view of this situation you may think it desirable to have some permanent contact maintained between the Administration and the group of physicists working on chain reactions in America."



Albert Einstein
Old Grove Rd.
Nassau Point
Peconic, Long Island

August 2nd, 1939

F.D. Roosevelt,
President of the United States,
White House
Washington, D.C.

Sir:

Some recent work by E.Fermi and L. Szilard, which has been communicated to me in manuscript, leads me to expect that the element uranium may be turned into a new and important source of energy in the immediate future. Certain aspects of the situation which has arisen seem to call for watchfulness and, if necessary, quick action on the part of the Administration. I believe therefore that it is my duty to bring to your attention the following facts and recommendations:

In the course of the last four months it has been made probable - through the work of Joliot in France as well as Fermi and Szilard in America - that it may become possible to set up a nuclear chain reaction in a large mass of uranium,by which vast amounts of power and large quantities of new radium-like elements would be generatnd. Now it appears almost certain that this could be achieved in the immediate future.

This new phenomenon would also lead to the construction of bombs, and it is conceivable - though much less certain - that extremely powerful bombs of a new type may thus be constructed. A single bomb of this type, carried by boat and exploded in a port, might very well destroy the whole port together with some of the surrounding territory. However, such bombs might very well prove to be too heavy for transportation by air.

-2-

...es has only very poor ores of uranium in moderate ...ome good ore in Canada and the former Czechoslovakia, ...e source of uranium is Belgian Congo.

...situation you may think it desirable to have some ...ined between the Administration and the group ... chain reactions in America. One possible way ... for you to entrust with this task a person ...d who could perhaps serve in an unofficial ...omprise the following:

...ment Departments, keep them informed of the ... forward recommendations for Government action, ...o the problem of securing a supply of uran...

...rimental work,which is at present being car... ...e budgets of University laboratories, by ...be required, through his contacts with ...to make contributions for this cause, ... co-operation of industrial laboratories ...t.

...as actually stopped the sale of uranium ...ch she has taken over. That she should ... perhaps be understood on the ground ...retary of State, von Weizsäcker, is ...ut in Berlin where some of the ... repeated.

Yours very truly,

(Albert Einstein)

Albert Einstein and Leo Szilard reenact the drafting of the above letter to President Roosevelt.

Photo: AIP/Niels Bohr Library
Letter: Franklin D. Roosevelt Library

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RESOURCE CARD
THE MANHATTAN PROJECT: PEOPLE & ORGANIZATION
HANDOUT (1d OF 4)

J. Robert Oppenheimer and General Leslie Groves

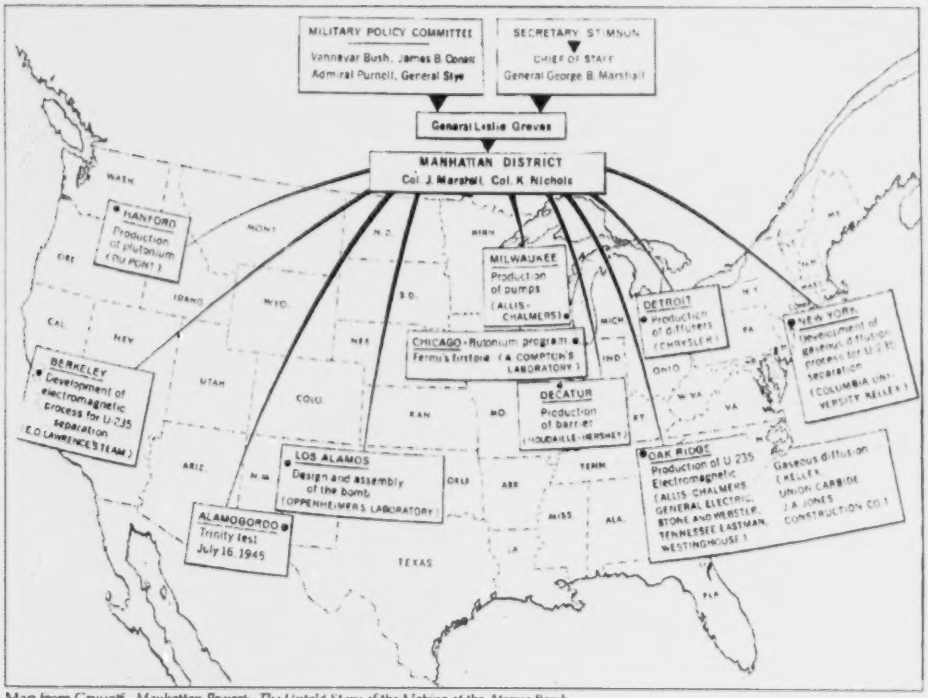
Photo: Associated Press

"In early 1943, I received a letter signed by General Groves and Dr. Conant, appointing me director of the laboratory, and outlining their conception of how it was to be organized and administered. The necessary construction and assembling of the needed facilities were begun. All of us worked in close collaboration with the engineers of the Manhattan District.

"The site of Los Alamos was selected in part at least because it enabled those responsible to balance the obvious need for security with the equally important need of free communication among those engaged in the work. Security, it was hoped, would be achieved by removing the laboratory to a remote area, fenced and patrolled, where communication with the outside was extremely limited. Telephone calls were monitored, mail was censored, and personnel who left the area—something permitted only for the clearest of causes—knew that their movements might be under surveillance. On the other hand, for those within the community, fullest exposition and discussion among those competent to use the information was encouraged.

"Almost everyone realized that this was a great undertaking. Almost eveyone knew that if it were completed successfully and rapidly enough, it might determine the outcome of the war. Almost everyone knew that it was an unparalleled opportunity to bring to bear the basic knowledge of art of science for the benefit of his country. Almost everyone knew that this job, if it were achieved, would be a part of history."

— J. Robert Oppenheimer quoted in Groueff, *Manhattan Project: The Untold Story of the Making of the Atomic Bomb*



Map from Groueff, *Manhattan Project: The Untold Story of the Making of the Atomic Bomb*
Reprinted by permission of Little, Brown and Company.

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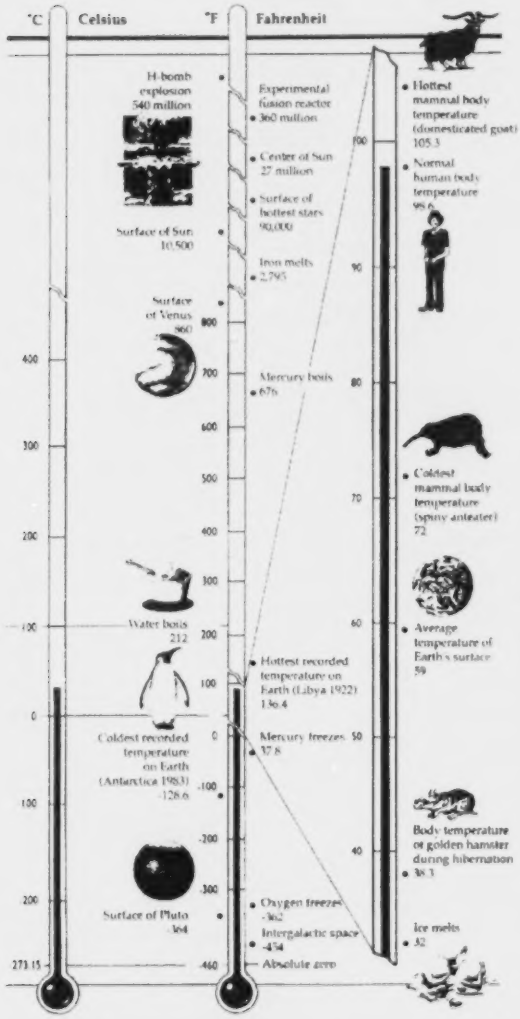
RESOURCE CARD
THE MANHATTAN PROJECT: "TRINITY" TEST EXPLOSION
HANDOUT (1e OF 4)


°C
Celsius
°F
Fahrenheit
H-bomb explosion 540 million
Surface of Sun 10,500
Surface of Venus 860
Water boils 212
Coldest recorded temperature on Earth (Antarctica 1983) -128.6
Surface of Pluto -364
Experimental fusion reactor 360 million
Center of Sun 27 million
Surface of hottest stars 90,000
Iron melts 2,795
Mercury boils 676
Hottest recorded temperature on Earth (Libya 1922) 136.4
Mercury freezes -37.8
Oxygen freezes -362
Intergalactic space -454
Absolute zero
Hottest mammal body temperature (domesticated goat) 105.3
Normal human body temperature 98.6
Coldest mammal body temperature (spiny anteater) 72
Average temperature of Earth's surface 59
Body temperature of golden hamster during hibernation 38.3
Ice melts 32

The "Trinity" test, .016 seconds after detonation.
Photo courtesy of Los Alamos Laboratory

"Saturday, July 14, 1945, the assembled gadget was hoisted to the top of the 100-foot tower on which it would be detonated. The firing unit was wired by late afternoon. Bradbury's schedule for Sunday, July 15, called for the staff to "look for rabbit's feet and four-leaved clovers." The detonation was scheduled for 4 a.m., Monday, July 16.

"Oppenheimer was in a state of high tension during the early morning hours, but, as predicted, the weather cleared and the countdown for the test was begun at 5:10 a.m. "As we approached the final minute," Groves recalled, "the quiet grew more intense.... As I lay there in the final seconds, I thought only what I would do if the countdown got to zero and nothing happened." At the control point, Joe McKibben ... threw the switch that started the precise automatic timer at minus 45 seconds.

"At 5:29:45 a.m., the gadget exploded with a force of 21,000 tons of TNT, evaporating the tower on which it stood. Groves' deputy, Gen. Thomas Farrell, wrote that the "whole country was lighted by a searing light with the intensity many times that of the midday sun. It was golden, purple, violet, gray and blue. It lighted every peak, crevasse and ridge of the nearby mountain range with a clarity and beauty that cannot be described but must be seen to be imagined. Seconds after the explosion came first the air blast pressing hard against the people, to be followed almost immediately by the strong, sustained awesome roar that warned of doomsday."

— Robert W. Seidel, Los Alamos Laboratory historian

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REPORTER INSTRUCTION CARD
NUCLEAR APPLICATIONS
HANDOUT (2a OF 4)

As a group, you will be presenting news reports on four topics related to the application of nuclear technology to our lives. They are: 1) Reactors—how do they work?, 2) Reactors—where?, 3) Reactor accidents—Chernobyl, and 4) Medical uses—radiation therapy.

Your group has been given one resource card for each topic. Your report can be in the form of a skit, an interview, an eyewitness account, or a reenactment. Be sure to include as much factual information about the topic as you can. You will have a total of 10 minutes for your team's news report.

Here are some things to think about:

- Try to include the basics of any good presentation: Who? What? Where? and When? You may also want to provide commentary or opinions on "Why?"
- Think about what people and information you would like to include in the report. Make a list of specific points to include.
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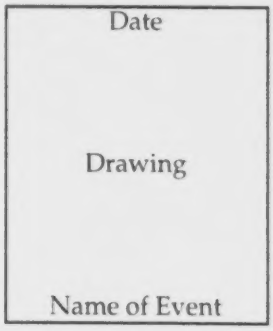
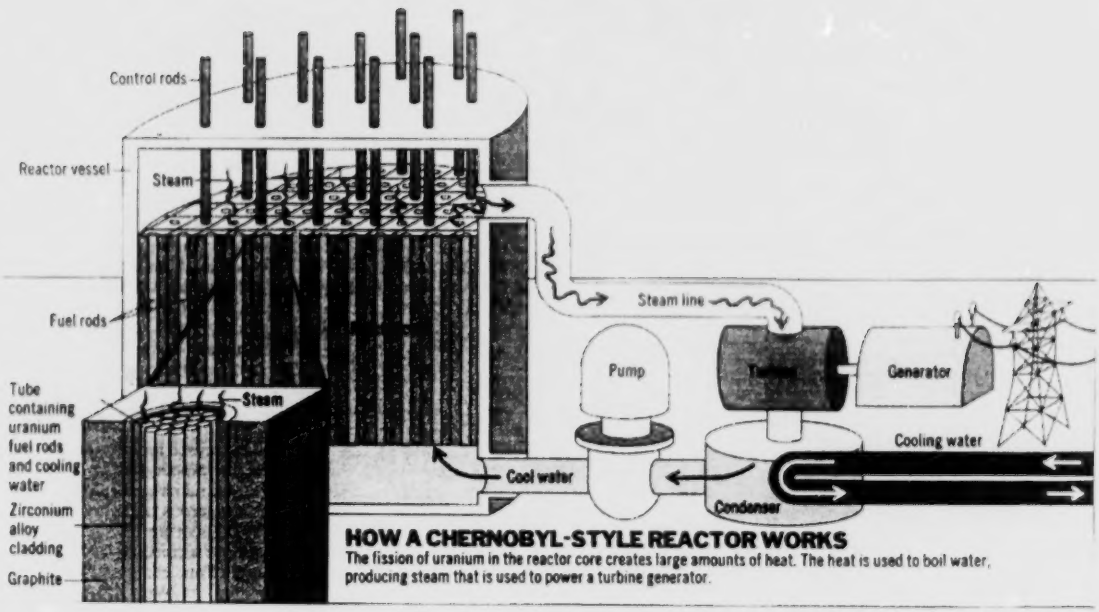
Finally, before you "go on the air," you need to have a timeline card ready for each event you present. The card will be placed on the timeline on the wall and include 1) the name of the event, 2) the date or dates on which it occurred, and 3) a drawing or symbol that represents what it's all about. Use 8-1/2 x 11" paper for your timeline card.



Have fun!

RESOURCE CARD
NUCLEAR APPLICATIONS:
REACTORS–HOW DO THEY WORK?
HANDOUT (2b OF 4)


Control rods
Reactor vessel
Steam
Fuel rods
Tube containing uranium fuel rods and cooling water
Zirconium alloy cladding
Graphite
Steam
Steam line
Pump
Generator
Cooling water
Cool water
Condenser
HOW A CHERNOBYL-STYLE REACTOR WORKS
The fission of uranium in the reactor core creates large amounts of heat. The heat is used to boil water, producing steam that is used to power a turbine generator.

Greenwald, *Time*, May 12, 1986.

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RESOURCE CARD
NUCLEAR APPLICATIONS:
REACTORS —WHERE?
HANDOUT (2c OF 4)

Map: Greenwald, *Time*, May 12, 1986

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RESOURCE CARDS
NUCLEAR APPLICATIONS: CHERNOBYL
HANDOUT (2d OF 4)

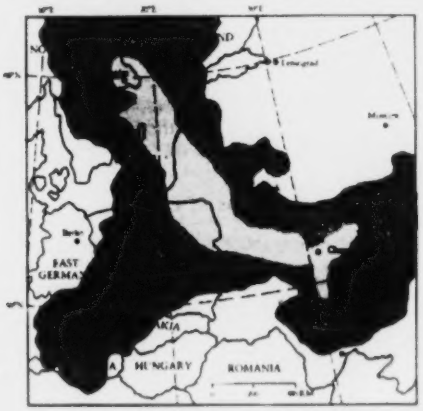
Deadly Meltdown

The first warning came in Sweden. At 9 a.m. on Monday, April 28, technicians at the Forsmark Nuclear Power Plant, 60 miles north of Stockholm, noticed disturbing signals blipping across their computer screens. Those signals revealed abnormally high levels of radiation, a sure sign of serious trouble. At first suspecting difficulties in their own reactors, the engineers searched frantically for a leak. When they found nothing, they lined up some 600 workers at the plant and tested them with a Geiger counter. This time the signals were even more alarming: the workers' clothing gave off radiation far above contamination levels. Outside, monitors took Geiger counter readings of the soil and greenery surrounding the plant. The result showed four to five times the normal amount of radioactive emissions. Something was wrong— terribly wrong.

Farther to the north and east, rain and gentle snow were falling over parts of Finland and Sweden. From there, as well as from points south and west, from Norway and Denmark, came the same disquieting signals. Somewhere, some mysterious source was spewing dangerous radiation into the atmosphere, into the air that people and plants were breathing. By now thoroughly frightened, the Swedes quickly confirmed that the source was not in their country. They immediately turned their suspicions southward, to their powerful neighbor, the Soviet Union.

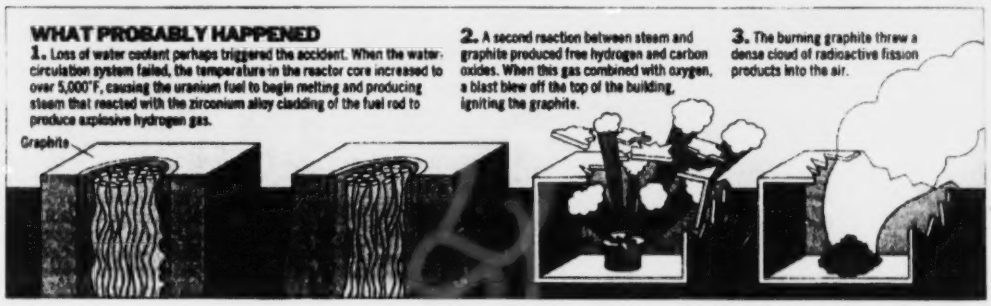
A glance at prevailing wind patterns confirmed their fear. For several days currents of air had been whipping up from the Black Sea, across the Ukraine, over the Baltic and into Scandinavia. But when the Swedes and their neighbors demanded an explanation from Moscow, they were met with denials and stony silence. For six hours, as officials throughout Scandinavia insisted that something was dangerously amiss, the Soviets steadfastly maintained that nothing untoward had happened.

Spread of Radiation from Chernobyl, April 29



Finally, at 9 p.m. on Monday, an expressionless newscaster on Moscow television read a four-sentence statement from the Council of Ministers that seemed to raise at least as many questions at it answered. The terse, almost grudging announcement said in full: "An accident has taken place at the Chernobyl power station, and one of the reactors was damaged. Measures are being taken to eliminate the consequences of the accident. Those affected by it are being given assistance. A government commission has been set up." The announcer then picked up another piece of paper and went on to discuss a story on a Soviet peace fund.

Thus began by far the gravest crisis in the troubled 32-year history of commercial atomic power. A catastrophe had occurred over the weekend at the Chernobyl plant, 80 miles north of Kiev....


WHAT PROBABLY HAPPENED
1. Loss of water coolant perhaps triggered the accident. When the water-circulation system failed, the temperature in the reactor core increased to over 5,000°F, causing the uranium fuel to begin melting and producing steam that reacted with the zirconium alloy cladding of the fuel rod to produce explosive hydrogen gas.
Graphite
2. A second reaction between steam and graphite produced free hydrogen and carbon oxides. When this gas combined with oxygen, a blast blew off the top of the building, igniting the graphite.
3. The burning graphite threw a dense cloud of radioactive fission products into the air.

Greenwald, *Time*, May 12, 1986

Map: Von Hippel, *The Bulletin of the Atomic Scientists* (August/September 1986)
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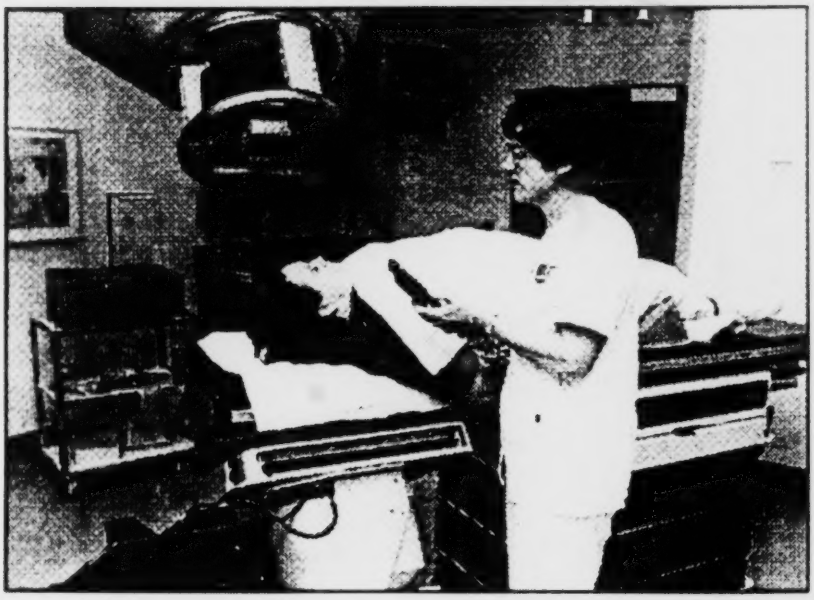
RESOURCE CARD
NUCLEAR APPLICATIONS—MEDICAL USES
HANDOUT (2e OF 4)



What Is Radiation Therapy?

Radiation is a special kind of energy carried by waves or a stream of particles. It can come from special machines or from radioactive substances. Many years ago doctors learned how to use this energy to see inside the body and find disease. You've probably seen a chest x-ray or x-ray pictures of your teeth or your bones. When radiation is used at high levels (many times those used for x-ray exams) this energy can be used to treat cancer and other illnesses. Special equipment is used to aim the radiation at tumors or areas of the body where there is disease. The use of high-energy rays or particles to treat disease is called radiation therapy. Sometimes it's called radiotherapy, x-ray therapy, cobalt therapy, electron beam therapy, or irradiation.

How Does Radiation Therapy Work?

High levels of radiation can kill cells or keep them from growing and dividing. Radiation therapy is a useful tool for treating cancer because cancer cells are growing and dividing more rapidly than many of the normal cells around them. In addition, most normal cells appear to recover more fully from radiation effects than cancer cells. Doctors carefully limit the intensity of treatments and the amount of normal tissue being treated so that the cancer will be harmed more than you will.

Radiation Therapy and You: A Guide to Self-Help During Treatment, National Cancer Institute, 1990

REPORTER INSTRUCTION CARD
WORLD EVENTS
HANDOUT (3a OF 4)

As a group, you will be presenting news reports on five of the many world events important in the atomic age. They are: 1) Hiroshima, 2) the Cuban Missile Crisis, 3) Cold War rhetoric and speeches, 4) the signing of the Nuclear Non-Proliferation Treaty, and 5) North Korea.

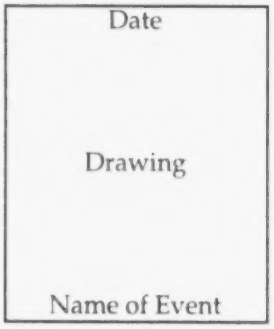
Your group has been given one resource card for each topic. Your report can be in the form of a skit, an interview, an eyewitness account, or a reenactment. Be sure to include as much factual information about the topic as you can. You will have a total of 10 minutes for your team's news report.

Here are some things to think about:

- Try to include the basics of any good presentation: Who? What? Where? and When? You may also want to provide commentary or opinions on "Why?"
- Think about what people and information you would like to include in the report. Make a list of specific points to include.
- Give characters and reporters names. Make props or costumes if you have time.
- Write out what you will be saying before the presentation.
- Create an interesting, believable, and accurate report for your part of the CNN broadcast.
- When you are making your presentation, really act your part. The more you put into it, the more interesting and memorable it will be.

As a group, determine the order of the events you'll be presenting and assign roles to each team member. Everyone should be involved in the report on at least one of the topics, but feel free to reuse people if you need to have more characters than there are team members.

Finally, before you "go on the air," you need to have a timeline card ready for each event you present. The card will be placed on the timeline on the wall and include 1) the name of the event, 2) the date or dates on which it occurred, and 3) a drawing or symbol that represents what it's all about. Use 8-1/2 x 11" paper for your timeline card.



Have fun!

RESOURCE CARD
WORLD EVENTS: HIROSHIMA
HANDOUT (3b OF 4)

"All the News That's Fit to Print"

The New York Times.

LATE CITY EDITION

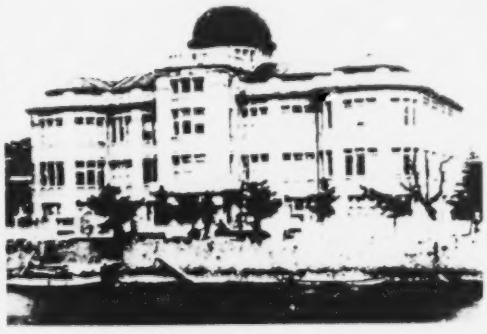
NEW YORK, TUESDAY, AUGUST 7, 1945. THREE CENTS

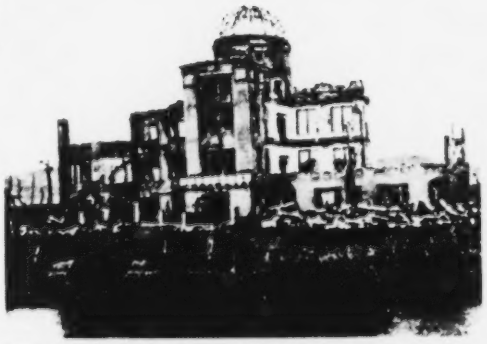
FIRST ATOMIC BOMB DROPPED ON JAPAN; MISSILE IS EQUAL TO 20,000 TONS OF TNT; TRUMAN WARNS FOE OF A 'RAIN OF RUIN'

Seeking water, people swarm to the water tanks and die even as they drink. The body of a young pregnant woman floats there, near Tenma-cho. Painting: ONO Kiaki, age 16 in 1945.

"Eyewitness accounts of the explosion all describe similar pictures. The bombs exploded with a tremendous flash of blue-white light, like a giant magnesium flare. The flash was of short duration and accompanied by intense glare and heat. It was followed by a tremendous pressure wave and the rumbling sound of the explosion, although it was clearly heard by others as much as fifteen miles away. A huge snow-white cloud shot rapidly into the sky and the scene on the ground was obscured first by a bluish haze and then by a purple-brown cloud of dust and smoke."

Before and After:





The Hiroshima-*ken Sangyo Shorei Kan* after the bomb. Known as the "atom bombed-dome," it is preserved intact as a monument. About November.

Photo: U.S. Army returned materials.

Photos and drawing: *Hiroshima-Nagasaki: A Pictorial Record of the Atomic Destruction*
Headline: *August 7, 1945.* © 1945 The New York Times Company. Reprinted by permission.

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RESOURCE CARD
WORLD EVENTS: CUBAN MISSILE CRISIS
HANDOUT (3c OF 4)

ON TUESDAY MORNING, OCTOBER 16, 1962, shortly after 9:00 o'clock, President Kennedy called and asked me to come to the White House. He said only that we were facing great trouble. Shortly afterward, in his office, he told me that a U-2 [plane] had just finished a photographic mission and that the [intelligence Community had become convinced that Russia was placing missiles and atomic weapons in Cuba.

Wednesday, October 17, late afternoon

[Soviet Minister of Foreign Affairs] Gromyko repeated that the sole objective of the U.S.S.R. was to "give bread to Cuba in order to prevent hunger in that country." As far as arms were concerned, the Soviet Union had simply sent some specialists to train Cubans to handle certain kinds of armament, which were only "defensive." He then said he wished to emphasize the "defensive" and that none of these weapons could ever constitute a threat to the United States.

Saturday, October 20

The President made his decision that afternoon in favor of the blockade. There was one final meeting the next morning, with General Walter C. Sweeney, Jr., Commander in Chief of the Tactical Air Command, who told the President that even a major surprise air attack could not be certain of destroying all the missile sites and nuclear weapons in Cuba. That ended the small, lingering doubt that might still have remained in his mind. It had worried him that a blockade would not remove the missiles—now it was clear that an attack could not accomplish that task completely, either.

Khrushchev's letter, Friday, October 26

This is my proposal, he said. No more weapons to Cuba and those within Cuba [are] withdrawn or destroyed, and you reciprocate by withdrawing your blockade and also agree not to invade Cuba. Don't interfere, he said, in a piratical way with Russian ships. "If you have not lost your self-control and sensibly conceive what this might lead to, then, Mr. President, we and you ought not to pull on the ends of the rope in which you have tied the knot of war, because the more the two of us pull, the tighter the knot will be tied. And a moment may come when that knot will be tied so tight that even he who tied it will not have the strength to untie it, and then it will be necessary to cut that knot, and what that would mean is not for me to explain to you, because you yourself understand perfectly of what terrible forces our countries dispose. Consequently, if there is no intention to tighten that knot, and thereby to doom the world to the catastrophe of thermonuclear war, then let us not only relax the forces pulling on the ends of the rope, let us take measures to untie that knot. We are ready for this."

Kennedy's letter, Saturday, October 27

"Dear Mr. Chairman:

"I have read your letter of October 26th with great care and welcomed the statement of your desire to seek a prompt solution to the problem. The first thing that needs to be done, however, is for work to cease on offensive missile bases in Cuba and for all weapons systems in Cuba capable of offensive use to be rendered inoperable, under effective United Nations arrangements.

"Assuming this is done promptly, I have given my representative in New York instructions that will permit them to work out this weekend—in cooperation with the Acting Secretary General and your representative—an arrangement for a permanent solution to the Cuban problem along the lines suggested in your letter of October 26th. As I read your letter, the key elements of your proposals—which seem generally acceptable as I understand them—are as follows:

"1. You would agree to remove these weapons systems from Cuba under appropriate United Nations observation and supervision; and undertake, with suitable safeguards, to halt the further introduction of such weapons systems into Cuba.

"2. We, on our part, would agree—upon the establishment of adequate arrangements through the United Nations to ensure the carrying out and continuation of these commitments—(a) to remove promptly the quarantine measures now in effect, and (b) to give assurances against an invasion of Cuba. I am confident that other nations of the Western Hemisphere would be prepared to do likewise."

President Kennedy understood that the Soviet Union did not want war, and they understood that we wished to avoid armed conflict. Thus, if hostilities were to come, it would be either because our national interests collided—which, because of their limited interests and our purposely limited objectives, seemed unlikely—or because of our failure or their failure to understand the other's objectives.

—Excerpted from Kennedy, *Thirteen Days: A Memoir of the Cuban Missile Crisis*

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RESOURCE CARD
WORLD EVENTS: COLD WAR
HANDOUT (3d OF 4)

'We'll Bury You,' West Is Warned

Diplomats Leave Polish Reception When Kremlin Chief Starts Diatribe

MOSCOW, Nov. 18 (AP) Nikita S. Khrushchev dampened a diplomatic reception again tonight with a political monologue so bitter that envoys from NATO nations and Israel stalked from the room. Egypt and Hungary were his main themes.

"If you don't like us, don't accept our invitations and don't invite us to come to see you," the Soviet Communist Party boss suggested, red-faced and gesticulating.

"Whether you like it or not, history is on our side. We will bury you."

The scene was a Polish Embassy reception following the signing of a Moscow-Warsawjoint declaration....

All returned to the reception when Khrushchev finished speaking.

Khrushchev's remarks about not accepting "our invitations" and his forecast that "we will bury you"was [sic] obviously directed at the Western diplomats....

Harold K. Milks, *Washington Post*, November 19, 1956

"The Evil Empire": President Reagan's Speech to the House of Commons, June 8, 1982

The decay of the Soviet experiment should come as no surprise to us. Wherever the comparisons have been made between free and closed societies—West Germany and East Germany, Austria and Czechoslovakia, Malaysia and Vietnam—it is the democratic countries that are prosperous and responsive to the needs of their people. And one of the simple but overwhelming facts of our time is this: of all the millions of refugees we've seen in the modern world, their flight is always away from, not toward, the Communist world. Today on the NATO line, our military forces face east to prevent a possible invasion. On the other side of the line, the Soviet forces also face east to prevent their people from leaving.

It is time that we committed ourselves as a nation—in both the public and private sectors—to assisting democratic development. . . .

What I am describing now is a plan and a hope for the long term—the march of freedom and democracy which will leave Marxism-Leninism on the ash heap of history as it has left other tyrannies which stifle the freedom and muzzle the self-expression of the people. And that's why we must continue our efforts to strengthen NATO even as we move forward with our zero-option initiative in the negotiations on intermediate-range forces and our proposal for a one-third reduction in strategic ballistic missile warheads.

Our military strength is a prerequisite to peace, but let it be clear we maintain this strength in the hope it will never be used. . . .

. . . all the democracies paid a terrible price for allowing the dictators to underestimate us. We dare not make that mistake again. So, let us ask ourselves, "What kind of people do we think we are?" And let us answer, "Free people, worthy of freedom and determined not only to remain so but to help others gain their freedom as well."

RESOURCE CARD
WORLD EVENTS: NORTH KOREA
HANDOUT (3e OF 4)

North Korea hasn't admitted to diverting plutonium for bomb-making, or possessing a bomb. It has refused to allow surprise inspections of its nuclear facilities, which are the best way to detect secret bomb-building plans.

The lack of immediate inspections is a flaw, but not fatal. Regular inspections of nuclear facilities, which have already started, can still catch nuclear cheaters.

U.S., North Korea nuclear pact
The U.S. and North Korea have agreed on steps to end the dispute over the North's nuclear program.
North Korea
United States
Dismantle nuclear plants capable of making plutonium for weapons
Assist in construction of atomic reactors less capable of producing plutonium
Permit international monitoring of nuclear facilities
Arrange for an interim oil supply until new reactors are complete
Renew diplomatic contacts with South Korea
Gradually ease restrictions on trade, investment
Rejoin Nuclear Non-Proliferation Treaty
Offer low-level diplomatic links

Graphics by The Knight-Ridder News Service

The deal rewards nuclear blackmail.

True. There's no way, short of war, to prevent a country from trying to do what North Korea did. Build a nuclear weapon and then trade it for money or diplomatic concessions from the West. The North Koreans "played their cards well," and probably got a better deal than they deserved, according to Donald Gregg, ambassador to South Korea during the Bush administration.

But which is worse, a defanged and economically developing North Korea, Iran or Iraq, or potentially threatening outlaw nations under no obligation to anyone to stop building bombs?

" U.S., North Korea Nuclear Pact," *San Jose Mercury News*, Wednesday, January 25, 1995.

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RESOURCE CARD
WORLD EVENTS: THE NPT SIGNING
HANDOUT (3f OF 4)

U.S., Russia Plan Talks On Restricting Missiles

Associated Press

. . .

Suggested in 1964

The first move toward negotiations for nuclear arms limitations came from President Johnson in January 1964 in a letter to then Soviet Premier Khrushchev, White House officials said.

When it became known nearly two years ago that Russia was building an anti-ballistic missile system around Moscow, new efforts were made to begin talks on limitation.

But the Soviets, while indicating interest in talks, delayed. When the United Nations General Assembly last month formally approved the draft of the nonproliferation treaty it called on the nuclear powers to seek further arms limitations.

"The march of mankind is toward the summit—not the chasm," Mr. Johnson said.

Most conspicuously absent from yesterday's signing ceremonies were France and Communist China. They have indicated they will not approve the treaty.

Secretary of State Dean Rusk, who signed for the United States, called the treaty "a major step" toward a rational world.

Ambassador Anatolly F. Dobrynin, who signed for Russia in the White House ceremony, called the document "an important international agreement" marking "significant progress."

The treaty is "one more practical step toward limiting the arms race," he said.

Sir Patrick Dean, the British Ambassador, hailed the treaty as "another measure for control of weapons of mass destruction."

Mr. Johnson said the treaty would commit the nations that do not have nuclear weapons not to produce or receive them in the future, assure that all nations benefit from the atom, and commit the nuclear powers to move forward "toward effective measures of arms control and disarmament."

The treaty "enhances the security of all nations by significantly reducing the danger of nuclear war among nations," the President said.

List of Countries Signing A-Treaty

Associated Press

Following is a list of the countries that signed the Nuclear Non-proliferation Treaty yesterday in Washington, London and Moscow.

There were 56 signatures in Washington, 23 in London and 36 in Moscow. Some countries signed the pact in all three capitals.

Washington: United States, Britain, Soviet Union, Nepal, Somalia, Iceland, Afghanistan, Laos, Tunisia, Ireland, Austria, Dominican Republic, Ghana, San Marino, Haiti, Cyprus, Nationalist China, Morocco, Botswana, Paraguay, Iran, Greece, Malaysia, Hungary, Colombia, New Zealand, Romania, Liberia, El Salvador, Panama, Norway, Bolivia, Mauritius, Denmark, Senegal, Czechoslovakia, Lebanon, Poland, Nigeria, Bulgaria, Venezuela, Nicaragua, Peru, Costa Rica, South Vietnam, Uruguay, Ceylon, Togo, Finland, Philippines, South Korea, Kenya, Barbados, Dahomey, Ivory Coast, Honduras.

(The White House had listed Jordan as a signer. It said later Jordan did not sign Monday for technical reasons but intended to do so.)

London: Soviet Union, United States, Britain, Afghanistan, Austria, Bulgaria, Ceylon, Czechoslovakia, Denmark, Finland, Hungary, Iceland, Iran, Laos, Lebanon, Nepal, Nicaragua, Norway, Poland, Romania, Somalia, Tunisia, Egypt.

Moscow: Hungary, Bulgaria, Ireland, East Germany, Austria, Czechoslovakia, Iran, Poland, Romania, Mongolia, Finland, Syria, Tunisia, Senegal, Denmark, Iceland, Greece, Laos, Lebanon, Nepal, Egypt, Malaysia, Afghanistan, Ceylon, Iraq, Nigeria, Norway, Chad, Somalia, Ghana, Morocco, Cyprus, New Zealand, United States, Britain, Soviet Union.

Excerpt from Kilpatrick, *The Washington Post*, July 2, 1968.
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KEY WORDS
HANDOUT (4a OF 4)

Key Word	Definition
arsenal	
atomic bomb	
chain reaction	
Cold War	
fission	
Manhattan Project	
NPT (Nuclear Non-Proliferation Treaty)	
nuclear reactor	

(over)

KEY WORDS - ANSWER KEY
HANDOUT (4b OF 4)

Key Word	Definition
arsenal	1. A governmental establishment for the storing, development, manufacturing, testing, or repairing of arms, ammunition, and other war material. 2. A stock of weapons
atomic bomb	An explosive weapon of great destructive power derived from the rapid release of energy in the fission of heavy atomic nuclei, as of uranium 235. Also called A-bomb, atomic bomb, fission bomb.
chain reaction	1. A series of events in which each induces or influences the next. 2. Physics. A multistage nuclear reaction, especially a self-sustaining series of fissions in which the release of neutrons from the splitting of one atom leads to the splitting of others.
Cold War	A state of political tension and military rivalry between nations that stops short of full-scale war.
fission	A nuclear reaction in which an atomic nucleus, especially a heavy nucleus such as an isotope of uranium, splits into fragments, usually two fragments of comparable mass, with the evolution of from 100 million to several hundred million electron volts of energy.
Manhattan Project	A secret project of the United States government from 1942 to 1945 to explore nuclear chain reactions and develop nuclear weapons.
NPT (Nuclear Non-Proliferation Treaty)	An international agreement which was signed in 1968, went into effect in 1970, and was renewed in 1995. Signatories pledge not to manufacture or acquire nuclear weapons and to place all nuclear facilities under international inspection.
nuclear reactor	Any of several devices in which a chain reaction is initiated and controlled, with the resulting heat typically used for power generation. The neutrons and fission products are used for military, experimental, and medical purposes.

(over)

Key Word	Definition
plutonium	A naturally radioactive, silvery, metallic transuranic element, occurring in uranium ores and produced artificially by neutron bombardment of uranium. Its longest-lived isotope is Pu 244 with a half-life of 76 million years. It is a radiological poison, specifically absorbed by bone marrow, and is used, especially the highly fissionable isotope Pu 239, as a reactor fuel and in nuclear weapons.
radiation	1. Emission and propagation of energy in the form of rays or waves. 2. Energy radiated or transmitted in the form of rays, waves, or particles. 3. A stream of particles or electromagnetic waves emitted by the atoms and molecules of a radioactive substance as a result of nuclear decay.
uranium	A heavy silvery-white metallic element, radioactive and toxic, easily oxidized, and having 14 known isotopes, of which U 238 is the most abundant in nature. The element occurs in several minerals, including uraninite and carnotite, from which it is extracted and processed for use in research, nuclear fuels, and nuclear weapons.

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Activity One

Supranational Organizations

"Here was the world's first attempt at nuclear arms control and it couldn't work because Americans and Russians couldn't trust each other."
- Molander Nichols speaking of the Baruch Plan

The importance of international policies in controlling the spread of nuclear technology quickly became apparent after the use of the first atomic weapons in Japan in 1945. Within a year, the United States drew up a proposal to the United Nations to create an "International Atomic Development Authority." The proposal, named the Baruch Plan after the man who presented it, called for placing much of the control over the development and use of nuclear technology in the hands of this international authority. Though many members of the United Nations were in favor of the plan, there was one prominent objection. The Soviet Union felt it put all countries except the United States at a disadvantage. Sovereign states would have to forgo the possibility for any future development of nuclear technology before the United States, alone in the nuclear club, relinquished its hold on it. The Soviet representative also objected that the plan would "lead to interference by the (proposed) control organ in the internal affairs of States."[1] The Soviets made a counterproposal, but ultimately a compromise was elusive.

Another attempt at international control was initiated several years later. In his "Atoms for Peace" speech to the U.N. in 1953, President Eisenhower proposed the establishment of an International Atomic Energy Agency (IAEA) to serve the international community through promotion of peaceful uses of nuclear technology such as energy, medicine, and research. The agency would be "responsible for the impounding, storage, and protection of contributed fissionable materials."[2] Amid concerns about nations' required financial contributions, the IAEA was eventually established as a U.N. affiliate organization in 1957. Its function is to conduct inspections and accounting procedures (safeguards) on declared nuclear sites in member countries to verify that nuclear materials are being used for peaceful pursuits. This first step in nuclear diplomacy was followed in the next decade by limited treaties banning nuclear tests in the Antarctic, in the atmosphere, and in outer space. The first nuclear weapons-free zone was created in Latin America with the Treaty of Tlatelolco in 1967 (see Appendix C for a timeline of treaties).

The current international-control regime for nuclear technology has its foundations in the IAEA and in the Non-Proliferation Treaty (NPT) of 1968. Though these agreements have been credited with greatly curbing the proliferation of weaponry and technology, there are many problems with the system. For example, the NPT was structured around a "bargain" in which the existent nuclear states (U.S., U.S.S.R., France, China, and U.K.) promised to withhold *weapons* technology from non-nuclear states and pursue negotiations to reduce their own arsenals. In return, the non-nuclear states promised not to pursue nuclear weapons,

but to focus only on their declared right to nuclear *energy* technology. This division between "haves" and "have-nots" has contributed to tensions between nations both inside and outside the treaty. There is a feeling of inequity and preference for those nations who developed the technology first. This has weakened the treaty in some respects.

A second issue regards the effectiveness of the NPT in limiting the spread of weapons to non-nuclear states. It contains no enforcement mechanisms per se. The IAEA does report on the activities of countries with which it has signed agreements. However, should a country choose to ignore its responsibilities under the NPT, there is nothing in the treaty prescribing consequences. This loophole is rather evident in the addition of as many as a dozen suspected or de facto nuclear states to the original five since the signing of the NPT. In addition, recent reports of illicit trade in nuclear secrets and hardware make it inevitable that more countries will soon be capable of building nuclear weapons.

The evolution from a strong proposal such as the Baruch Plan, which would control nuclear technology with a body having widespread authority over all development and licensing, to an appreciably weaker agreement, which relies on an international agency with no enforcement provisions illustrates well the difficulty in creating a system that will serve and be accepted by the international community as a whole. Issues such as sovereignty, trust, enforcement, and equality continue to trouble nations as was evident in the SALT and START negotiations in the 1970s and 1980s as well as the 1995 NPT Renewal Conference. The task is to create a system in which each party's interests are served by compliance and, conversely, the consequences of breaching the treaty are sufficiently harsh as to make this an unlikely option. It is a difficult balance to reach.

Outline of Activity

Students review excerpts from the Non-Proliferation Treaty (NPT) and the Baruch Plan and read North Korean and Indian perspectives on the International Atomic Energy Agency (IAEA). As a group, they discuss the reasons for international nuclear agreements as well as some of the reasons why nations might not support such agreements. They then create a brief play dramatizing the deliberations leading to either the NPT or the Baruch Plan.

Extension Questions

1. What responsibilities do nuclear states have under the treaty? What responsibilities do non-nuclear states have? What rights do they have?
2. Who has the most power under the NPT? How is this different from the ideas for control in the Baruch Plan? Why do you think these changes were made in the NPT?

Related Issues

- Sovereignty
- Developed/developing world
- SALT, START

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Endnotes

[1]Quoted in Michael Mandelbaum, *The Nuclear Question* (Cambridge: Cambridge University Press, 1979), p. 28.

[2]Dwight D. Eisenhower, "Address Before the General Assembly of the United Nations on Peaceful Uses of Atomic Energy," New York City, December 8, 1953, in *Public Papers of the Presidents of the United States* (Washington, D.C.: National Archives and Records Service, 1960), pp. 813-822.

ACTIVITY CARD

As a group, study the *Resource Cards* and discuss the questions below:

1. Why have nations signed international treaties or agreements to control nuclear weapons?
2. What are some of the reasons that it has been difficult to get nations to agree to a set of rules that regulate nuclear technology?
3. How would you view international treaties if you were from a nation that already had nuclear weapons? If you were from a nation that didn't have nuclear weapons?
4. Many nations have not signed the NPT. What are some reasons that a nation might not sign?

GROUP TASK

As a group, create a short play that dramatizes nations coming together to create either the Baruch Plan or the Nuclear Non-Proliferation Treaty (NPT). Include roles that represent both nuclear and non-nuclear nations. Include arguments both for and against the treaty. Plan to share your play with the rest of the class.

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RESOURCE CARD (1 OF 3)

THE BARUCH PLAN

This proposal, presented by Bernard M. Baruch in 1946, offered a plan to create an international atomic development authority that would be entrusted with all phases of the development and use of atomic energy, including:

1. Managerial control or ownership of all atomic-energy activities potentially dangerous to world security.
2. Power to control, inspect, and license all other atomic activities.
3. The duty of fostering the beneficial uses of atomic energy.
4. Research and development responsibilities . . . intended to put the Authority in the forefront of atomic knowledge...

Mr. Baruch further stated:

> We must provide the mechanism to assure that atomic energy is used for peaceful purposes and preclude its use in war. To that end, we must provide immediate, swift, and sure punishment of those who violate agreements that are reached by nations . . . . [T]he people want a program not composed merely of pious thoughts but of enforceable sanctions—an international law with teeth in it.

—Excerpted from Speed, *The International Control of Nuclear Weapons*

RESOURCE CARD (2 OF 3)

Treaty on the Non-Proliferation of Nuclear Weapons

Signed at London, Moscow and Washington on 1 July 1968.
Entered into force on 5 March 1970.
Depositaries: UK, US and Soviet governments.

The States concluding this Treaty, hereinafter referred to as the "Parties to the Treaty",

Considering the devastation that would be visited upon all mankind by a nuclear war and the consequent need to make every effort to avert the danger of such a war and to take measures to safeguard the security of peoples,

Believing that the proliferation of nuclear weapons would seriously enhance the danger of nuclear war,

In conformity with resolutions of the United Nations General Assembly calling for the conclusion of an agreement on the prevention of wider dissemination of nuclear weapons,

Undertaking to co-operate in facilitating the application of International Atomic Energy Agency safeguards on peaceful nuclear activities, . . .

Have agreed as follows:

Article I

Each nuclear-weapon State Party to the Treaty undertakes not to transfer to any recipient whatsoever nuclear weapons or other nuclear explosive devices or control over such weapons or explosive devices directly, or indirectly; and not in any way to assist, encourage, or induce any non-nuclear-weapon State to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices, or control over such weapons or explosive devices.

Article II

Each non-nuclear-weapon State Party to the Treaty undertakes not to receive the transfer from any transferor whatsoever of nuclear weapons or other nuclear explosive devices or of control over such weapons or explosive devices directly, or indirectly; not to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices; and not to seek or receive any assistance in the manufacture of nuclear weapons or other nuclear explosive devices. . . .

Article VI

Each of the Parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control. . . .

Article X

1. Each Party shall in exercising its national sovereignty have the right to withdraw from the Treaty if it decides that extraordinary events, related to the subject matter of this Treaty, have jeopardized the supreme interests of its country. It shall give notice of such withdrawal to all other Parties to the Treaty and to the United Nations Security Council three months in advance. Such notice shall include a statement of the extraordinary events it regards as having jeopardized its supreme interests. . . .

—Excerpted from Gray, *Briefing Book on the Nonproliferation of Nuclear Weapons*

RESOURCE CARD (3 OF 3)
NON-NUCLEAR STATES

A18 TUESDAY, JUNE 14, 1994 ...

North Korea Pulls Out of Nuclear Body

KOREA, From A1

the inspectors are ejected, the U.N. watchdog agency would lose any chance of directly observing any new plutonium processing.

North Korea's action fell short of a formal withdrawal from the nuclear Non-Proliferation Treaty, which bars development or possession of nuclear arms. The country threatened to withdraw from the pact in March 1993 but sus[pended] threat two months later; [it] pears to be holding that [it] serve for retaliation a[gainst] threatened U.N. sanction

The North Korean ann[ouncement] said the IAEA action "g[ravely] croached "upon the digni[ty] ereignty of our republic" it a prelude to imposition tions being proposed by States, South Korea and the inspection issue.

The Clinton admini[stration] clined to comment directly on the North Korean announcement pending a clarification of whether the inspectors will be forced to leave. But Assistant Secretary of State Robert Gallucci said, "It certainly would be a very, very serious development for the worse" if the inspectors were ejected.

The North Korean announcement said the IAEA action "gravely" encroached "upon the dignity and sovereignty of our republic" . . .

Smith and Reid, *The Washington Post*, June 14, 1994
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"In short, the NPT regime seeks to impose unequal obligations on the nuclear-weapon and the non-nuclear-weapon states in the field of nuclear energy development. It endeavours to perpetuate the privileged position of the five 'haves' in both the civil and military fields of nuclear technology. Instead of adopting a forward-looking viewpoint, the NPT takes a rather retrograde step by polarizing the world between the few nuclear-weapon States and the rest of the States. It arbitrarily divides States into two categories—one entitled to reach the highest peak in technological advancement and the other deprived of that privilege."

Jagdish P. Jain, *Nuclear India*, 1979

(Note: IAEA refers to the International Atomic Energy Agency, which carries out activities related to the peaceful development and verification of nuclear energy's uses.)

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INDIVIDUAL REPORT

Name:_____

Assume you are a scientist who worked on the development of the first atom bomb. Write a letter to the leader of your country describing why you believe it would be important to create international agreements controlling the development and use of nuclear technology.

Activity Two

Nation-States

"Countries do not want to give up their sovereign prerogatives, especially the most basic one of all, that of going to war."

- Michael Mandelbaum, *The Nuclear Question*

Approximately once every five years, a new country gains the ability to make nuclear weapons. Since the United States developed the first bomb in 1945, other nations developing nuclear capacity have included the Soviet Union, the United Kingdom, France, China, Israel, India, South Africa, and Pakistan. In addition, three "instant nuclear states"—Ukraine, Kazakhstan, and Belarus—emerged with the collapse of the Soviet Union. As one might expect, the number of nuclear weapons in the world has risen correspondingly. The bulk of them lie in the arsenals of the United States and Russia; however, significant numbers are held in the several other nations. Given the highly technical nature of nuclear weapons and the desire on the part of the early nuclear powers to limit their spread, this is a development that merits attention.

A major contributor to this proliferation horizontally and vertically—to more countries and to a greater extent within a country, respectively—has been trade, both legal and illegal. Under the Nuclear Non-Proliferation Treaty, the sharing of peaceful nuclear technology, such as reactors, with all nations was explicitly encouraged. This equipment has sometimes then been converted to weapons-related activities as we have seen happen in India, Iraq, and North Korea. In recent years, reports of illicit trade in both weapons and raw materials have increased. Compromised security over much of the former Soviet arsenal, the renewed determination in some countries to acquire weapons and the passing of restricted technology by nuclear nations to would-be allies have all contributed to a thriving market.

The motivations to acquire nuclear technology range from prestige and power to defense and a sense of security. No longer comfortable with their position under the nuclear umbrellas of either the United States or the now defunct Soviet Union, many nations see the necessity to forge their own path. It is often mentioned that the permanent members of the U.N. Security Council are all nuclear states. It would follow that to be taken seriously in international politics, one needs to acquire (or threaten to acquire) nuclear weapons.

With nuclear missiles as the weapon of choice for many, conflicts between nations have taken on a particular urgency in the post-WWII era. The Cuban Missile Crisis focused the issue of security for all who watched. The Soviet Union's actions were simultaneously perceived to be protecting the security interests of its ally, Cuba, and threatening those of the United States. More recently, the situation in Iraq after the Persian Gulf War and North Korea's violation of, threat to withdraw from, and subsequent reaffirmation of the NPT have been cause for concern. Each

was resolved more or less peacefully. Nonetheless, they serve as stark reminders to how close a nuclear conflict is to our everyday lives.

Outline of Activity

Students examine political cartoons that illustrate some reasons why nations desire nuclear technology and review a graph that illustrates the horizontal spread of nuclear technology. They read a brief news article about India's position on the NPT. They discuss motives behind the development of nuclear capacity and consider why individual nations may or may not want to enter into international agreements regarding nuclear technology. As a group they develop two political cartoons illustrating reasons for and against developing nuclear capacity in their own country.

Extension Questions

1. What is the responsibility of nuclear nations toward non-nuclear nations in sharing nuclear information and resources?
2. Why would a country be afraid to give away its power to make its own decisions about nuclear technology?

Related Issues

- National security
- Sovereignty
- Monitoring and inspection of nuclear facilities

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ACTIVITY CARD

As a group, examine the *Resource Cards* and discuss the questions below:

1. What is meant by "hostile pairs"? How does this relationship affect the number of nations with nuclear weapons?
2. What motives for acquiring nuclear weapons are shown in the cartoons? Can you think of other motives?
3. In what ways might a country's security be affected when it signs a treaty like the NPT that limits the amount or kind of weapons it can have?
4. Would the world be safer if nuclear arms were controlled by international organizations or a number of countries?

GROUP TASK

As a group, create two political cartoons—one showing the reasons why your own country might want to develop nuclear weapons and a second showing the reasons why it should not develop nuclear weapons. Be prepared to share your cartoons with the class.

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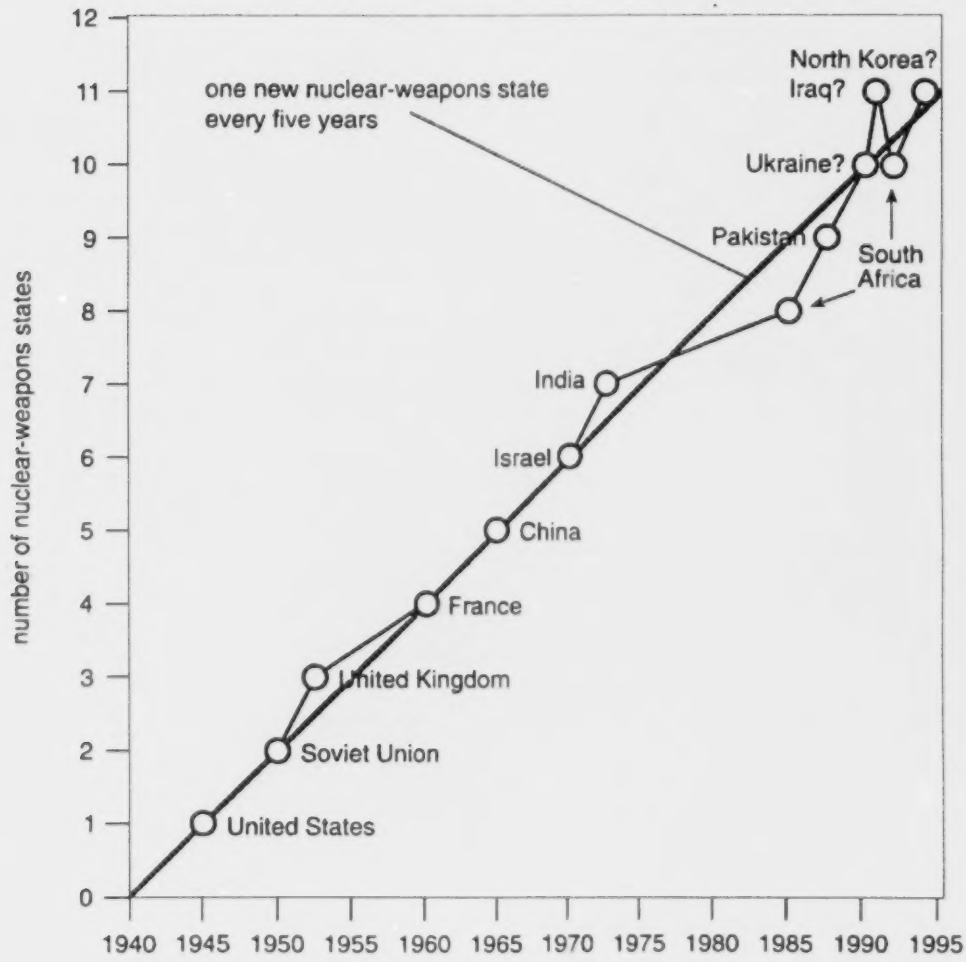
RESOURCE CARD (1 OF 3)
"HOSTILE PAIRS"

"Nuclear states have tended to come in hostile pairs. American capability led to the Soviet Union's, the Soviet Union's to China's, China's to India's, India's to Pakistan's, and Israel's spurred Iraq's efforts to acquire bombs of its own. Countries are vulnerable to capabilities that they lack and others have."

—Kenneth Waltz, *The Spread of Nuclear Weapons: A Debate*



May, *American Scientist* (November/December 1994)

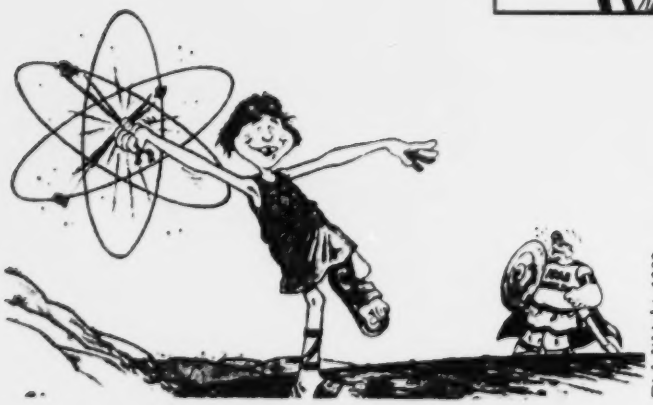
RESOURCE CARD (2 OF 3)
POLITICAL CARTOONS

Courtesy of Frank Cotham.

"... why nations go nuclear... may be viewed according to "three categories of incentives: international political power or prestige, military or security incentives, and domestic political incentives."

Social Education, March 1990

Bill Sanders, 1982
Courtesy of Cartoon Art Museum, San Francisco, CA



Dick Wright, 1980
Courtesy of Cartoon Art Museum, San Francisco, CA

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The Times of India, April 22, 1995

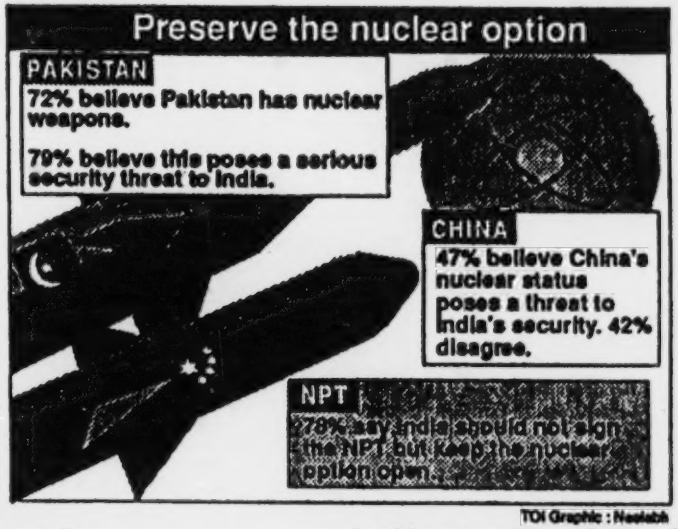
Public support India's stand on NPT

By K. Balakrishnan and Gouri Chatterjee

NEW DELHI, April 21.

A public opinion poll conducted for *The Times of India* in nine metropolitan cities shows that India's stand on the nuclear non-proliferation treaty (NPT) has the firm backing of the people.

Seventy-eight per cent of the respondents say that India should not sign the treaty but keep the nuclear option open in the interests of national security. Most respondents do not find the offer made by Pakistani Prime Minister Benazir Bhutto to sign the treaty if India does so too a credible one. About 72 per cent believe that Pakistan already has the bomb and 79 per cent feel that Pakistan's pursuit of the nuclear option poses a serious security threat to India.


Preserve the nuclear option
PAKISTAN
72% believe Pakistan has nuclear weapons.
79% believe this poses a serious security threat to India.
CHINA
47% believe China's nuclear status poses a threat to India's security. 42% disagree.
NPT
78% say India should not sign the NPT but keep the nuclear option open.
TOI Graphic : Neelabh

The security threat posed by China's nuclear status is not seen to be of the same order --a reflection of improved Sino-Indian relations. Forty-seven per cent of the respondents perceive China as posing a potential nuclear threat to India while 42 per cent disagree.

Presently, 179 nations are taking part in the review conference on NPT under way in New York where the U.S. is pushing hard for the unconditional and indefinite extension of the 25-year-old treaty.

India, Pakistan and Israel are the three significant nations holding out against signing. Israel has the support of the U.S. in staying out of the treaty till the West Asia peace process is concluded to its satisfaction. In the light of Pakistan's position, international pressure will mount on India to sign a treaty which it considers flawed and discriminatory.

The opinion poll was conducted for *The Times of India* by MODE, a leading market research agency. Altogether, 2,321 adults were interviewed in the nine metropolitan cities of Bombay, Delhi, Calcutta, Madras, Bangalore, Hyderabad, Ahmedabad, Lucknow and Cochin.

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INDIVIDUAL REPORT

Name:_____

What are the main arguments given by individual countries for being able to make their own decisions about whether or not to develop and use nuclear technology?

Activity Three

"EVERYONE"

"I can predict with a high degree of confidence, that the indefinite combination of human fallibility and the existence of nuclear weapons carries a very, very high risk of the destruction of society."

—Robert McNamara, former Secretary of Defense, 1994.

The development of nuclear weapons occurred in a wartime environment of great secrecy. At war's end, many suggestions to control further development of nuclear technology were made, ranging from maintenance of complete secrecy to relative openness about the discoveries and possible applications in an effort to discourage future competition. After several decades, the international community has come to rely on a system based on the Nuclear Non-Proliferation Treaty (NPT) of 1968. It emphasized sharing with non-nuclear states those elements of the technology that can be applied to peaceful uses (such as energy) while denying them the additional information and equipment necessary to make weapons. Nations signing the treaty believed it presented the greatest hope for limiting the number of nations possessing nuclear weapons technology.

Nevertheless, there has been significant proliferation in the decades since the treaty went into force. There are many reasons. The spirit and the letter of these agreements have been breached on several occasions by both nuclear and non-nuclear states. In addition, it has become increasingly clear that some technology used in reactors also has applications in weapons production. These "dual-use" items have not been as closely controlled as nonproliferation proponents would have liked. Finally, the spread of nuclear weapons to new nations has had a side effect; the emergence of each new nuclear state has brought into question the efficacy of the NPT and whether nonproliferation is truly feasible or, for that matter, desirable.

The NPT Extension Conference of 1995 generated public discussion on many of these issues. Was the treaty worth extending? Should it be extended indefinitely or limited to five or ten years? Several countries, disenchanted with the results of 25 years under the NPT, threatened to withhold their vote for extension altogether. Citing leaks in the control regime and the growing arsenals of the declared nuclear states, they voiced concerns about forgoing nuclear weapons if other nations were not doing the same. They argued that in the absence of a guarantee, it may be more realistic and fair to allow all countries to possess nuclear weapons, not just the five "declared" states.

This point of view finds supporters among academics as well as policy makers. In a global extension of the concept of Mutually Assured Destruction, they argue for the increased stability and deterrence in a world where all nations possess nuclear weapons. If everyone were to have a nuclear weapon, the personal consequences of any act of aggression would be so great as to make peaceful resolution of the conflict more attractive. The counterargument, of which the United

States is a strong supporter, rests on the sheer probability that the more countries or individuals who have the technology, the more likely it is to be used. Such use could be in the context of war or in an accidental launching. Also frightening is the possibility that violent political groups would threaten to use a nuclear weapon to further their cause.

The stakes are high when it comes to decisions regarding nuclear weapons. Each actor is concerned primarily with protecting its own interests. Unfortunately, these are not always shared by other actors. Indeed, conflict among nations may be inevitable. The question is "What is the best way to guarantee that conflict does not result in nuclear war?"

Outline of Activity

Students examine political cartoons and brief quotes from a debate about the relative danger or lack of danger in the spread of nuclear technology. They read a brief news report describing the controversy around an incomplete nuclear reactor in Iran. They discuss whether or not nations have a "right" to develop and use technology and the potential consequences of "everyone" having access to nuclear technology. As a group, they develop a poem that reflects a world in which everyone has nuclear weapons and other forms of nuclear technology.

Extension Questions

1. What is the difference between deterrence and defense?
2. How have countries used the concepts of deterrence or defense to justify their development of nuclear technology?
3. Is it possible to prevent nations from obtaining and using nuclear technology?

Related Issues

- Deterrence vs. defense
- Nuclear accidents
- Terrorism
- The "right" to nuclear technology

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ACTIVITY CARD

As a group, examine the *Resource Cards* and discuss the questions below:

1. In what ways are the opinions of Scott Sagan and Kenneth Waltz regarding the spread of nuclear weapons different?
2. In what ways is Iran's goal to build a nuclear reactor controversial?
3. Why do the existing nuclear powers believe they have a right to obtain and use nuclear technology?
4. Would the world be safer if every country had nuclear weapons?

GROUP TASK

As a group, write a poem about a world in which everyone has nuclear technology—both weapons and non-military technology such as power plants. Practice reading your poem aloud and prepare to share it with the class.

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RESOURCE CARD (1 OF 4)
POLITICAL CARTOONS

Courtesy of Frank Cotham, 1993

"Quick! Write that down!"
Courtesy of Frank Cotham, 1993

RESOURCE CARD (2 OF 4)
WHY WORRY?

"On the technical side, we should be worried about whether new nuclear states' weapons will be designed in a sage manner. The reports that the design of the Iraqi nuclear bomb was so flawed that it 'could go off if a rifle bullet hit it' certainly are not comforting."

— Scott Sagan, *The Spread of Nuclear Weapons: A Debate*, 1995

COMFORTING THOUGHT FOR THE DAY

Steve Greenberg, 1984
Cartoon Art Museum, San Francisco, CA

RESOURCE CARD (3 OF 4)
WHY NOT WORRY?

What does the Nuclear Future hold?

What will a world populated by a larger number of nuclear states look like? . . . I have found many reasons for believing that with more nuclear states the world will have a promising future.

. . . Nuclear weapons reduced the chances of war between the United States and the Soviet Union and between the Soviet Union and China. One must expect them to have similar effects elsewhere. Where nuclear weapons threaten to make the cost of wars immense, who will dare to start them?

. . . The likelihood of war decreases as deterrent and defensive capabilities increase. Nuclear weapons make wars hard to start. These statements hold for small as for big nuclear powers. Because they do, the gradual spread of nuclear weapons is more to be welcomed than feared.

—Kenneth Waltz, *The Spread of Nuclear Weapons: A Debate, 1995*

RESOURCE CARD (4 OF 4)
IRAN'S NUCLEAR REACTOR

Iran's Nuclear Goals Lie in Half-Built Plant

By ELAINE SCIOLINO

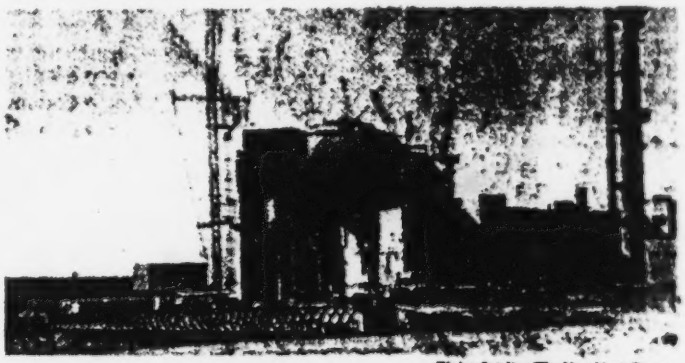
BUSHEHR, Iran, May 16 — At a vast construction site baked by the sun and buffeted by the salty Persian Gulf air, two partly built nuclear reactors are frozen in time.

For the Iranians, the enormous steel and concrete structures represent what might have been and what might be, a symbol of their legal right to develop nuclear energy and of their potential to become a great regional power.

For the Americans, the reactors are an ominous sign of Iran's determination to build nuclear weapons within the next decade, and a threat to American national security.

There is no evidence that this site, 730 miles south of Teheran, is a center for a weapons program, and inspectors from the International Atomic Energy Agency have never reported suspicious activity.

But the plant has strained Washington's relationship with Moscow, aggravated already inimical relations between the United States and Iran and trained the spotlight on a place that has yet to produce either a gram of enriched uranium or a watt of electricity.



Elaine Sciolino/The New York Times

Russians plan to finish reactor No. 1, one of two in Iran.

The United States and Germany say they have amassed substantial evidence that Iran is secretly buying components and technology from abroad that point to a determined weapons program. The American view is that the Bushehr project is dangerous because it will bring hundreds, perhaps thousands of Russian experts to Iran who could help build nuclear bombs.

Despite the insistence of Iran's leaders that they have no intention of becoming a nuclear power, they have invited few outsiders to Bushehr, and in opening up the complex to a foreign reporter, they clearly intended to prove they have nothing to hide.

"We only want to get the benefit of the huge amount of money we have already spent," Reza Amrollahi, the head of Iran's nuclear program, said in an interview in Teheran. "We have the right, just like any other country, to develop a peaceful nuclear energy program."

The New York Times, May 19, 1995
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INDIVIDUAL REPORT

Name:_____

Write one or more paragraphs giving your own position on whether or not everyone should have access to nuclear technology.

Activity Four

Physicists/Scientists

"The nuclear experts are similar to the priests of traditional societies, whose role it was to serve as intermediaries between ordinary people and the gods."
- Michael Mandelbaum, *The Nuclear Question*

In December 1938, the first successful experiment in fission was carried out in Germany. Nine months later, Albert Einstein wrote to the President of the United States describing the event and its implications for future energy sources as well as its possible military uses. As a result, President Roosevelt established the Manhattan Project in 1942, which was charged with the development of an atomic weapon to be used against the Nazis in World War II. Ultimately involving thousands of physicists, chemists, and engineers, the project was successful, giving those who had unleashed the power of the atom a new voice and significance in policy-making circles.

The primary site of research and synthesis for physicists was in Los Alamos, New Mexico—site of the Los Alamos Project. The civilian lab, under the direction of J. Robert Oppenheimer, drew upon the expertise of the best scientists from the United States and Europe. Though the possibility of an atomic weapon existed in theory, much experimentation and precise calculation had to be carried out to determine a final and, it was hoped, workable design. Their work culminated in the successful "Trinity" test explosion in the New Mexico desert on July 16, 1945.

The Los Alamos Project scientists were, ostensibly, the most knowledgeable people on the planet when it came to nuclear weapons and there was great admiration for these miracle workers. However, the unity with which they were able to tackle the design of an atomic bomb was not apparent when policy issues arose. Dissension arose around the decision to drop a bomb on Hiroshima. Before the Trinity test, a special scientific panel was asked to comment on the initial use of the new weapon. It saw "no alternative to direct military use." [1] At about the same time, another group of scientists at the Manhattan Project's Chicago lab submitted an unsolicited memorandum suggesting that "a technical but not military demonstration" of the bomb be made.[2] The day after the Trinity test, a petition signed by still another group of scientists called on the President to consider the moral responsibilities associated with the weapon. (This petition never made it to the President.) And yet a poll conducted of 150 scientists two days later indicated the largest portion of them thought a military demonstration should be made in Japan. The ultimate decision to use the bomb on a military target may or may not have reflected the input of these groups. What the documentation does show, however, is that the opinions of these civilians were *considered* by government and military officials at a very important point in history.

Over the years, scientists have continued to exert varying degrees of power in the decision-making process. After the Soviet Union carried out its first nuclear explosion in 1949, the United States began a program to develop the H-bomb, enormously more powerful than its predecessor. Oppenheimer, as head of the Atomic Energy Commission's advisory

committee, opposed its construction. Several other scientists also refused to take part in it. Despite this opposition, President Truman overruled the committee and went ahead with the help of physicist Edward Teller.

Decades later, when President Reagan proposed the Star Wars program in 1983, he was met with enormous resistance from the scientific community ready to express its opinion once again. A petition that circulated at the University of Illinois and Cornell University called the plan "ill-conceived and dangerous."[3] It was eventually signed by thirty-seven hundred faculty, graduate students, and other junior research staff nationwide who pledged not to participate in the necessary research. Similar opposition groups surfaced pointing out technical problems and making political statements that Star Wars should not be pursued. Little work has been done on this program in recent years and it has been effectively killed.

In commenting on the appropriate role for scientists in government, author C.P. Snow praised their socially imaginative minds and their particular ability at foresight which has been developed through their experiences in science. He wrote, "I believe scientists have something to give which our . . . society is desperately short of . . . . That is my deepest reason for wanting scientists in government."[4] His critics are wary of translating a scientist's success in his or her own field to that of politics, for the two fields are fundamentally different. A scientist may or may not be more fit for government leadership than anyone else. Nevertheless, in an ever more technical society, our reliance on science becomes more apparent. The appropriate role for its leaders may not be so clear.

Outline of Activity

Students review documents, handbills, and other print materials that explore the role of scientists in influencing policy on nuclear technology. They then discuss some of the positions regarding the advantages and disadvantages of science influencing policy. As a group, they create a revolutionary new technology and then decide how they, as scientists, would advise the head of their government about the use of this technology.

Extension Questions

1. If you were a scientist who developed a powerful nuclear weapon, what responsibility do you believe you would have in shaping its use?
2. What would happen if government officials never consulted with scientists when making decisions?

Related Issues

- Policy and policy making
- Responsibility of scientists in policy development
- Manhattan Project
- Atomic Energy Commission
- Strategic Defense Initiative (Star Wars)

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Endnotes

[1]Stoff, Michael B., Jonathan F. Fanton, and R. Hal Williams, eds., *The Manhattan Project: A Documentary Introduction to the Atomic Age* (Philadelphia: Temple University Press, 1991), p. 150.

[2]Ibid., p. 138.

[3]Kogut, John, and Michael Weissman, "Taking the Pledge Against Star Wars," *The Bulletin of the Atomic Scientists*, January 1986, p. 28.

[4]Snow, C.P., "Science and Government," in *Public Affairs*, ed., C.P. Snow (New York: Charles Scribner's Sons, 1971), pp. 145-6.

ACTIVITY CARD

As a group, examine the *Resource Cards* and then answer the following questions:

1. Who were the people writing the "Top Secret" memo? What role did they see for themselves in government?
2. How did the scientists involved with the "Anti-SDI" pledge hope to influence the government?
3. Why do some people feel that scientists and physicists should be involved in making decisions about the use of nuclear technology?
4. How heavily should government decision-makers rely on scientists to make decisions about nuclear technology?

GROUP TASK

As a group, imagine some new scientific discovery that could affect the world as dramatically as did the discovery of fission and the creation of the atom bomb. Your discovery should be useful for both peaceful and military purposes. Draw a picture or diagram of your "discovery." Discuss what recommendations you would make to the president of your country about the use of this new scientific information. Write these policy recommendations on a sheet of chart paper and be prepared to share them with the rest of the class.

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RESOURCE CARD (1 OF 4)
TWO VIEWS

. . . I want scientists active in all the levels of government. . . .

Any scientist realises that his subject is moving in time—that he knows incomparably more today than better, cleverer, and deeper men did twenty years ago. He knows that his pupils, in twenty years, will know incomparably more than he does. Scientists have it within them to know what a future-directed society feels like, for science itself, in its human aspect, is just that.

That is my deepest reason for wanting scientists in government.

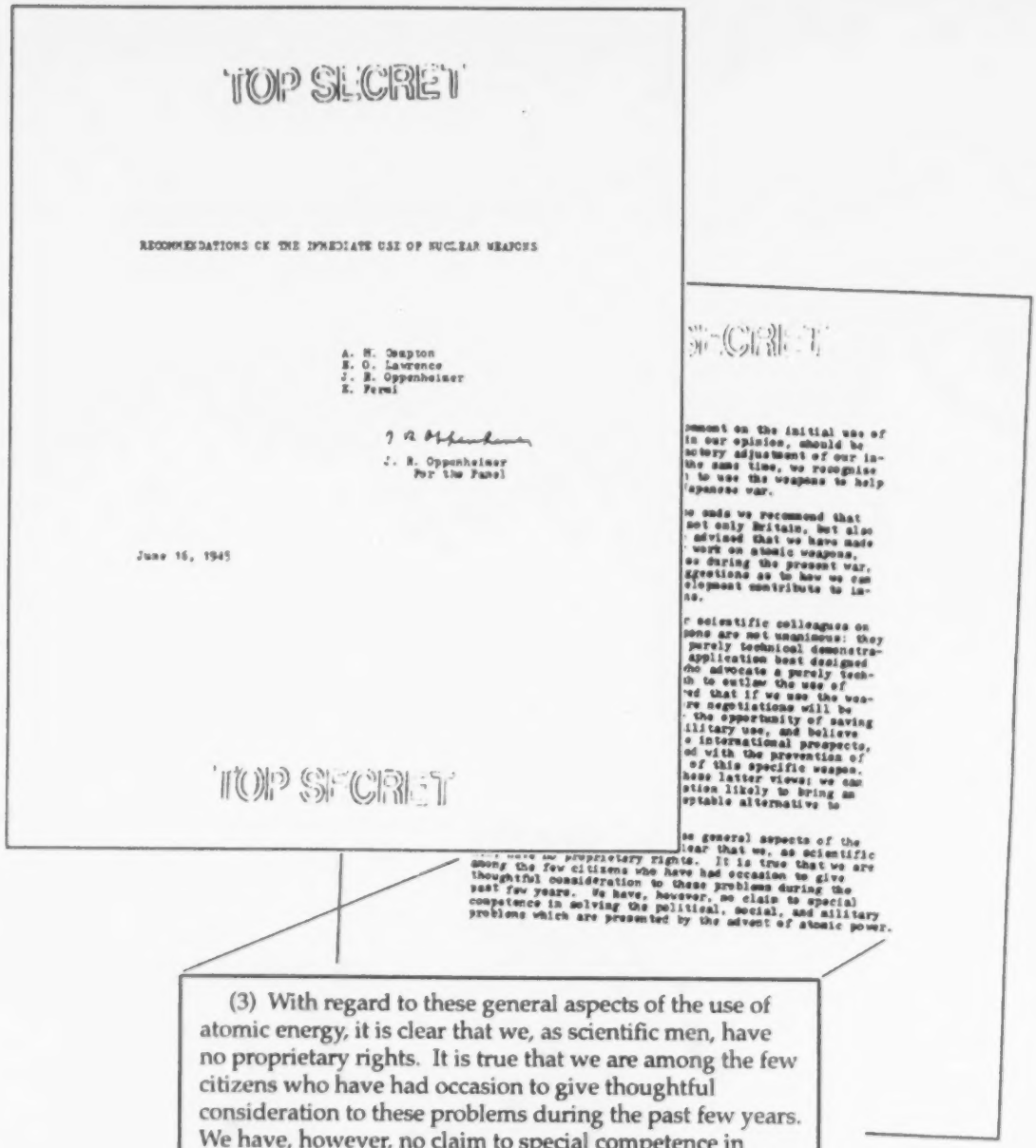
—C. P. Snow
Author, Physicist, 1960
Public Affairs

I wish at the outset to repudiate C. P. Snow, who intimates in one of his books that scientists should be entrusted with the world because they are a little bit better than other people. My view, based on long and painful observation, is that professors are somewhat worse than other people, and that scientists are somewhat worse than other professors.

—Robert M. Hutchins
University President, 1963
Science, Scientists, and Politics

RESOURCE CARD (2 OF 4)

"Recommendations On The Immediate Use of Nuclear Weapons"
Report of Panel Headed by J. Robert Oppenheimer, 1945



TOP SECRET

RECOMMENDATIONS ON THE IMMEDIATE USE OF NUCLEAR WEAPONS

A. H. Compton
E. O. Lawrence
J. R. Oppenheimer
E. Fermi

J. R. Oppenheimer
For the Panel

June 16, 1945

TOP SECRET

...SECRET

...nment on the initial use of
...in our opinion, should be
...actory adjustment of our in-
...the same time, we recognize
...to use the weapons to help
...Japanese war.

...ends we recommend that
...not only Britain, but also
...advised that we have made
...work on atomic weapons,
...as during the present war,
...gestions as to how we can
...elopment contributes to in-
...ns.

...scientific colleagues on
...ons are not unanimous: they
...purely technical demonstra-
...application best designed
...who advocate a purely tech-
...h to outlaw the use of
...ed that if we use the wea-
...re negotiations will be
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...ilitary use, and believe
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...of this specific weapon.
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...tion likely to bring an
...eptable alternative to

...e general aspects of the
...lear that we, as scientific
...have no proprietary rights. It is true that we are
among the few citizens who have had occasion to give
thoughtful consideration to these problems during the
past few years. We have, however, no claim to special
competence in solving the political, social, and military
problems which are presented by the advent of atomic power.

(3) With regard to these general aspects of the use of atomic energy, it is clear that we, as scientific men, have no proprietary rights. It is true that we are among the few citizens who have had occasion to give thoughtful consideration to these problems during the past few years. We have, however, no claim to special competence in solving the political, social, and military problems which are presented by the advent of atomic power.

Manhattan Engineer District Records, National Archives, Washington, D.C.

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RESOURCE CARD (3 OF 4)
SCIENTISTS AGAINST "STAR WARS"

Anti-SDI pledge

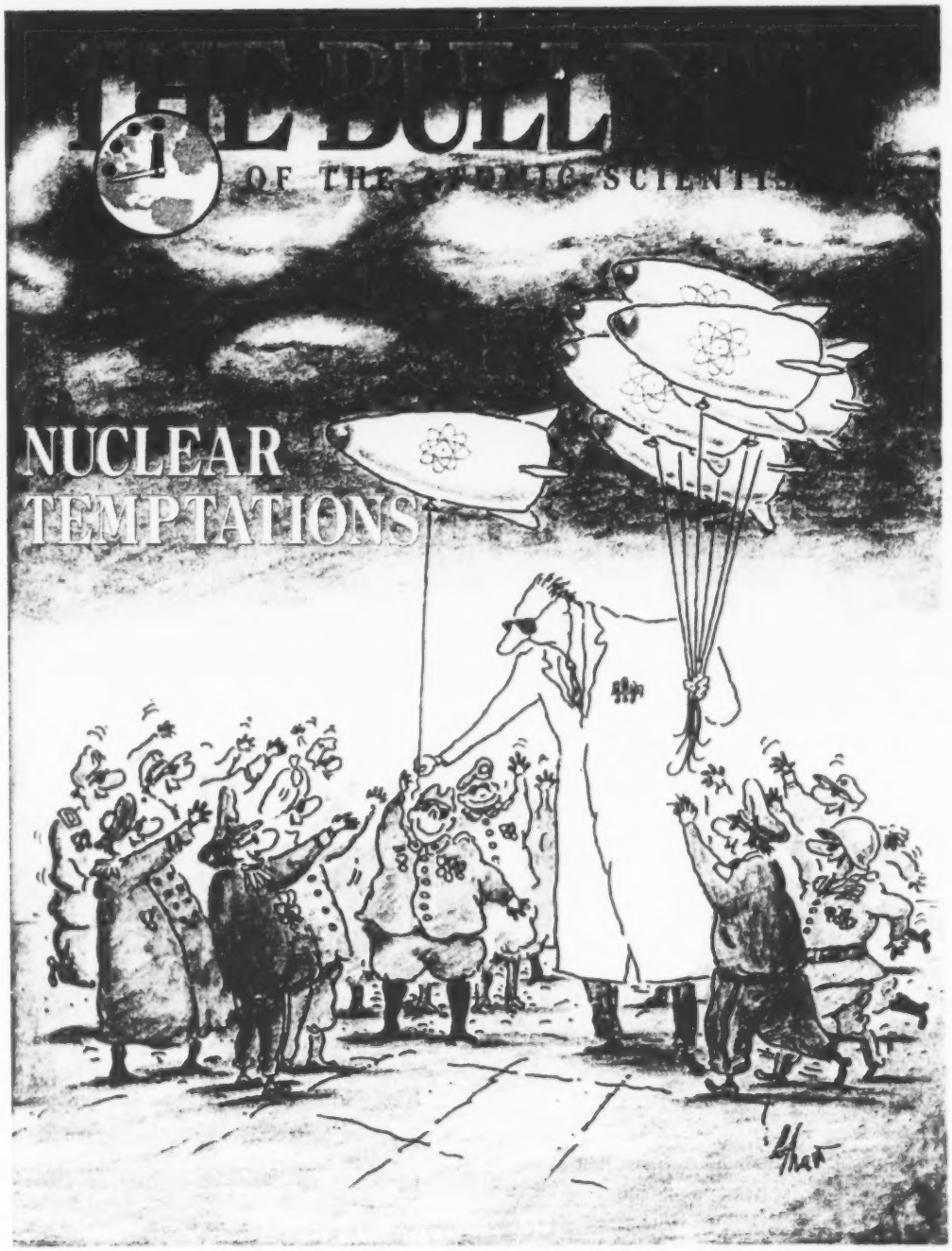
We, the undersigned scientists and engineers, believe that the Strategic Defense Initiative (SDI) program (commonly known as Star Wars) is ill-conceived and dangerous. Anti-ballistic-missile defense of sufficient reliability to defend the population of the United States against a Soviet attack is not technically feasible. A system of more limited capability will only serve to escalate the nuclear arms race by encouraging the development of both additional offensive overkill and an all-out competition in anti-ballistic-missile weapons. The program will jeopardize existing arms control agreements and make arms control negotiation even more difficult than it is at present. The program is a step toward the type of weapons and strategy likely to trigger a nuclear holocaust. For these reasons, we believe that the SDI program represents, not an advance toward genuine security, but rather a major step backwards.

Accordingly, as working scientists and engineers, we pledge neither to solicit nor accept SDI funds, and we encourage others to join us in this refusal. We hope together to persuade the public and Congress not to support this deeply misguided and dangerous program.

Petition circulated at Cornell University and the University of Illinois in 1986. Signed by approximately 3,700 faculty, students, and researchers nationwide.

Kogut and Weissman, *The Bulletin of the Atomic Scientists* (January 1986) Reprinted by permission. © 1986 by the Educational Foundation for Nuclear Science, 6042 South Kimbark Avenue, Chicago, Illinois 60637. A one-year subscription is $36.

RESOURCE CARD (4 OF 4)
THE SCIENCE CARNIVAL



Courtesy of Frank Cotham and *The Bulletin of the Atomic Scientists* (June 1993)
Reprinted by permission. © 1993 by the Educational Foundation for Nuclear Science,
6042 South Kimbark Avenue, Chicago, Illinois 60637. A one-year subscription is $36.

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INDIVIDUAL REPORT

Name:_____

If you were a scientist, what role would you want to have in influencing decisions about the use of scientific information?

Activity Five

Business and Nuclear Industry

"Just as one sees the risks that nuclear energy poses for society, it's equally necessary to weigh the risks that society runs in not opting for nuclear energy."
—K.H. Beckurts, president of the European Society of Nuclear Energy

The nuclear reactor was the first civilian application of nuclear technology. Amidst great expectations that it would provide abundant energy for a rapidly industrializing world, production of new reactors expanded quickly. Great Britain opened its Calder Hall reactor in 1953, soon followed by the Shippingport reactor in the United States in 1957. Since then over 600 nuclear reactors have been built in twenty-four countries. To varying degrees, the technology has provided significant portions of these nations' energy outputs. As of 1991, the United States derived 21% of its electricity from nuclear power, Bulgaria produced 36%, Taiwan generated 52%, and France led all nations at 75%. [1]

The purpose of a reactor is to induce the same nuclear reaction present in nuclear weapons but in a controlled environment. This is done with "moderators," which simply slow down the rate at which neutrons travel from atom to atom and thus the rate at which energy is released. The heat from the reaction is harnessed and converted to electricity by allowing it to heat water, which then drives a steam combine. Uranium fuel for the reactor is plentiful and its cost is low relative to coal or oil. In addition, "burning" the fuel does not produce the "greenhouse gases" associated with fossil fuels.

Despite these clear advantages, the popularity of nuclear reactors has declined in the United States over the past fifteen years. By the end of the 1980s, no new reactors were on order. Plant construction cost overruns and lower-than-expected prices for oil have caused many people to reconsider the benefits of nuclear energy. The accumulation of radioactive waste is posing increased financial and environmental costs for communities near plants. And dramatic accidents, such as those at Three Mile Island in 1979 and at Chernobyl in 1986, clearly demonstrate the risks present in the event of a malfunction or meltdown.

The issue of nuclear energy and its contribution to national security is still alive, however. In light of the oil shock of the early 1970s and uncertainties about supplies from some oil-rich Middle East countries, nations are looking to nuclear energy as a secure domestic source for electricity. Its prominence in many parts of the world has also been aided by provisions of the Nuclear Non-Proliferation Treaty. Article VI of the treaty guarantees that "Nothing in this Treaty shall be interpreted as affecting the *inalienable right* of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes."[2] Many non-nuclear states have exercised this right in their efforts to meet growing needs for energy and self-sufficiency.

Unfortunately, the expansion of nuclear energy production facilities also has a negative effect on national security. There is an inherent

similarity between power plant and warhead fission reactions. The fuel for reactors is distinguishable from that for weapons only by the purity of certain isotopes, namely U-235 (uranium) and P-239 (plutonium). The less pure forms will not sustain a reaction fast enough to be effective for a bomb, but there are several ways to transform reactor-grade fuel to weapons-grade by increasing the concentration of the relevant isotopes. At various points in this fuel cycle, plutonium can be diverted, providing an essential ingredient for a bomb. This creates a difficult situation for policy makers. In fulfilling responsibilities under the NPT and acting to protect a nation's own energy supplies, they are also contributing to the proliferation of technology and materials having military uses.

It is clear the nuclear power has had beneficial effects on world fossil fuel consumption. However, these gains may or may not be outweighed by the increased risk of radiation leaks worldwide and the proliferation risks associated with the illegal conversion of plants to military uses.

Outline of Activity

Students examine an advertisement for nuclear energy and they review data on the cost-effectiveness of nuclear power. They analyze a flow chart that shows the potential relationship between nuclear power plants and nuclear weapons. They then address several questions evaluating the role of business in the development and application of nuclear technology. As a group, they design an advertising campaign for a nuclear industry promoting the development of a nuclear power plant.

Extension Questions

1. What relationship do nuclear reactors have to nuclear bombs?
2. Why would a business be motivated to invest in the development and sale or use of nuclear technology?

Related Issues

- National security
- Government regulation and regulatory agencies
- Military-industrial complex
- Energy policy

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[1]John Greenwald, "Time to Choose," *Time*, April 29, 1991, p. 61.

[2]Treaty on the Non-Proliferation of Nuclear Weapons, Article VI, Section 1.

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ACTIVITY CARD

As a group, read the *Resource Cards* and discuss the questions below:

1. Who are the people pictured in the advertisement? What is the "alternative" the ad is talking about? Explain the feeling you have (or that the advertiser would like you to have) when you see this ad.

2. What are some of the goals a business might have in using or promoting the use of nuclear energy?

3. What responsibility, if any, does a business have to its community when introducing nuclear technology?

4. Why do some governments make rules and regulations about the use of nuclear technology?

5. What are some fears people have about nuclear reactors and other uses of nuclear energy?

GROUP TASK

Imagine that you are a group of businesspeople who are trying to locate a nuclear power plant in your community. Design a public relations campaign to convince local citizens that the power plant would be good for your community. You may include advertisements for local newspapers, radio or television commercials, posters, or other public relations devices. Share your campaign with the rest of the class.

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RESOURCE CARD (1 OF 4)
ADVERTISEMENT, 1991

If you're uneasy about nuclear electricity, consider the alternatives.

Over and over again, Middle East instability has threatened much of the world's energy supplies—including America's, where we now import over 40% of our oil. It's time this country achieved a balanced energy strategy that reduces our vulnerability to the whims of tyrants.

Nuclear energy is part of that strategy. With 112 plants licensed to operate in the U.S., nuclear-generated electricity already cuts America's oil imports by 740,000 barrels every day. That's more than we imported from Iraq and Kuwait before the war.

Still, we need more nuclear plants. To meet America's growing electricity demands and to bolster our independence from dangerously unstable energy sources. All without emitting any greenhouse gases or air pollutants. For more information, write to the U.S. Council for Energy Awareness, P.O. Box 66080, Dept. OT01, Washington, D.C. 20035.

Nuclear energy means more energy independence.

© 1991 USCEA

Courtesy of the U.S. Council for Energy Awareness

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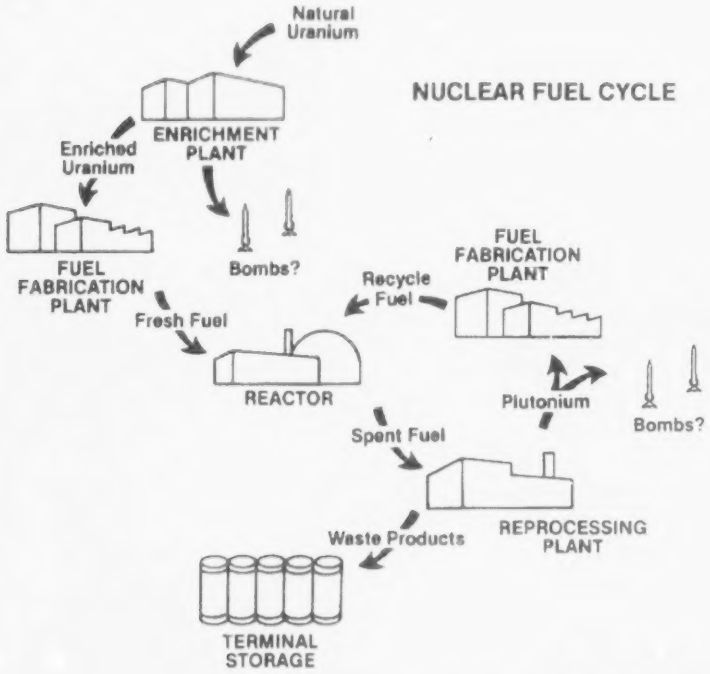
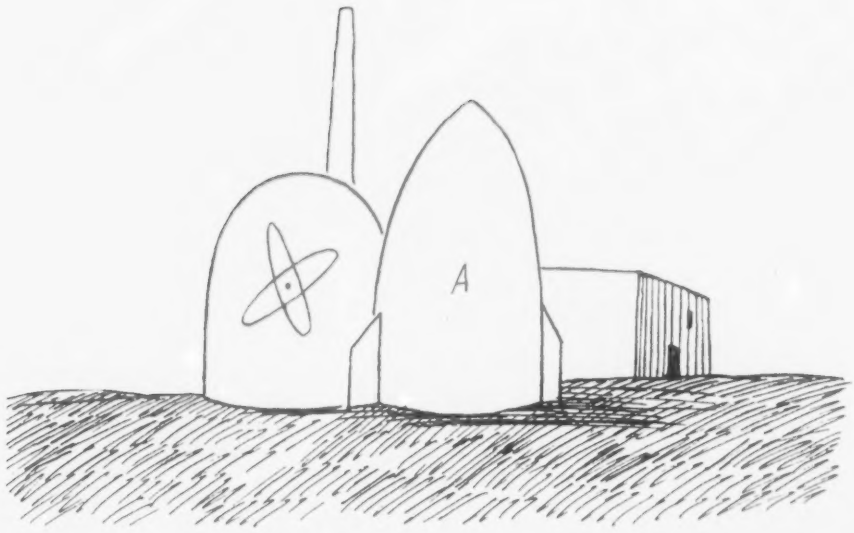
RESOURCE CARD (2 OF 4)
NUCLEAR FUEL: FOR PEACE OR WAR?



The Harvard Nuclear Study Group, *Living with Nuclear Weapons*



Paul Valerry, Courtesy of *Commonweal*

RESOURCE CARD (3 OF 4)
COSTS OF ENERGY: NUCLEAR VS. COAL

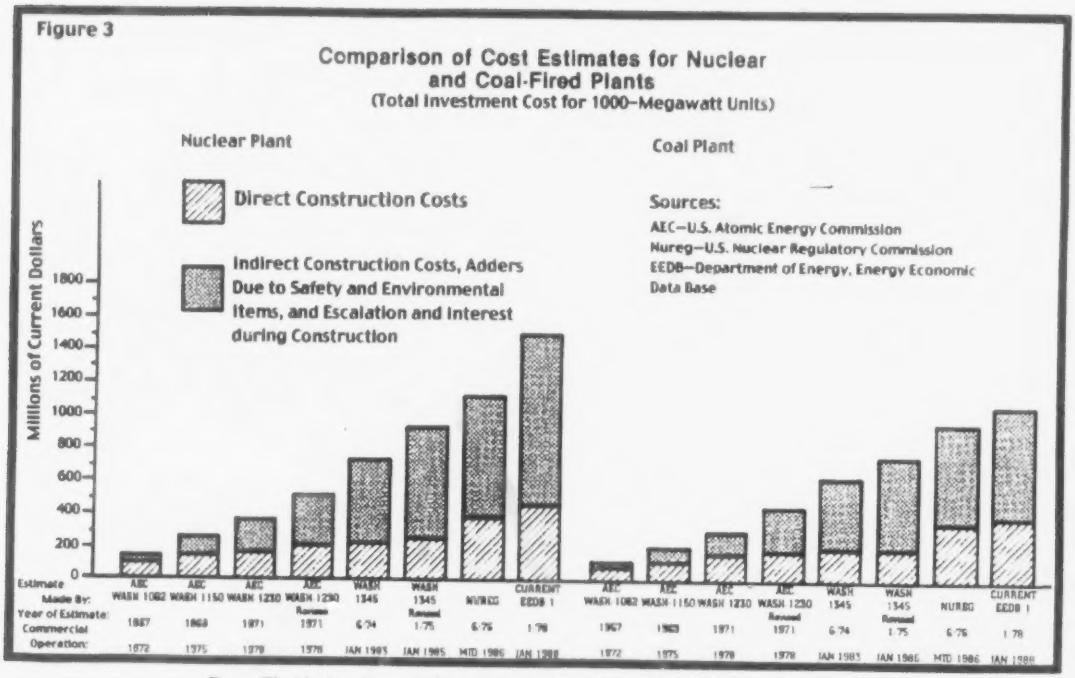
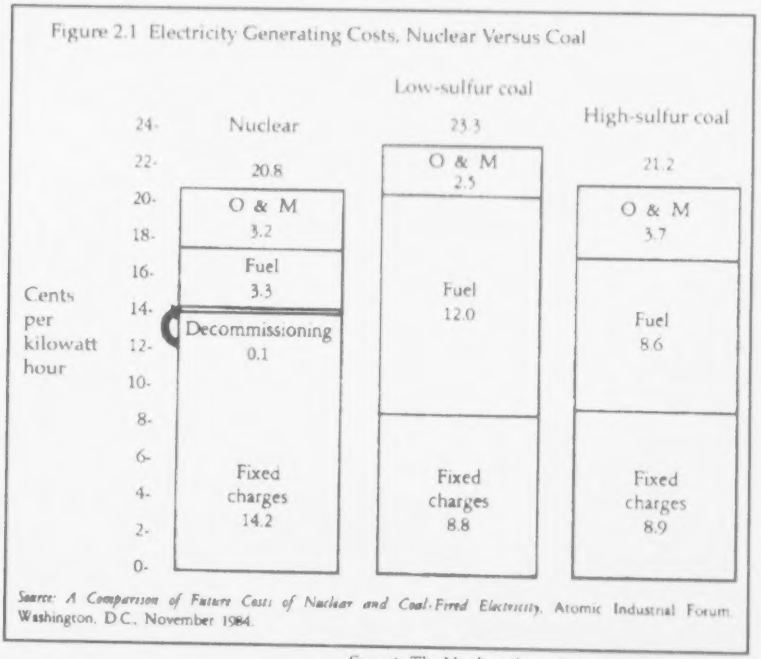


Figure 3
Comparison of Cost Estimates for Nuclear and Coal-Fired Plants
(Total Investment Cost for 1000-Megawatt Units)
Nuclear Plant
Coal Plant
Direct Construction Costs
Indirect Construction Costs, Adders Due to Safety and Environmental Items, and Escalation and Interest during Construction
Sources:
AEC—U.S. Atomic Energy Commission
Nureg—U.S. Nuclear Regulatory Commission
EEDB—Department of Energy, Energy Economic Data Base
Millions of Current Dollars
0
200
400
600
800
1000
1200
1400
1600
1800
Estimate Made By:
Year of Estimate:
Commercial Operation:
AEC WASH 1082 1967 1972
AEC WASH 1150 1968 1975
AEC WASH 1230 1971 1978
AEC WASH 1230 Revised 1971 1978
WASH 1345 6-74 JAN 1985
WASH 1345 Revised 1-75 JAN 1985
NUREG 6-75 MID 1986
CURRENT EEDB 1 1-78 JAN 1988
AEC WASH 1082 1967 1972
AEC WASH 1150 1968 1975
AEC WASH 1230 1971 1978
AEC WASH 1230 Revised 1971 1978
WASH 1345 6-74 JAN 1985
WASH 1345 Revised 1-75 JAN 1985
NUREG 6-76 MID 1986
CURRENT EEDB 1 1-78 JAN 1988

Fenn, *The Nuclear Power Debate: Issues and Choices*© 1981 by Investor Responsibility Research Center, Inc. Reproduced with permission of Greenwood Publishing Group, Inc., Westport, CT.



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RESOURCE CARD (4 OF 4)

CONNECTICUT RIVER, JULY 1976

Even before morning
reaches the river, the nervous deer
have slipped back into the brush.
Already speckled trout
are gasping in the fisherman's creel.
His dog is chasing tadpoles
through the shallows.

Before this day is over,
children will run home as always
with skinned knees and wet socks.
Before the light leaves the water,
bathing suits will be drying
on the clotheslines all over town again.
Before the deer
come down to drink at the river
tonight, eighty-three thousand gallons
of radioactive water
will have finally reached Long Island.

—Cathy Young Czapla,
in Sklar, *Nuke Rebuke: Writers & Artists Against Nuclear Energy & Weapons*

Bill Shore, 1990
Cartoon Art Museum, San Francisco, CA

activity five: business and nuclear industry

INDIVIDUAL REPORT

Name:_____

What might happen if businesses were put in charge of decisions about the use of nuclear technology without any government regulation or supervision?

Activity Six

"No One"

"Complete disarmament would require some form of world government to deter action of one nation against another."[1]

The Harvard Nuclear Study Group, *Living with Nuclear Weapons*

Weaponry has always been an integral element of human conflict. From rocks and arrows to cannons and machine guns, the incentive over time is to develop new armaments that will enhance one's ability to fight an enemy. Indeed, it was in a race with Germany during World War II that the atomic bomb was developed. The advent of this newest weapon, the nuclear warhead, unique in its capability for mass destruction, has triggered a prolonged and widespread effort to reverse the trend of escalation. Predictably, it has proven more difficult to destroy weapons than to create them. Nations are unlikely to give up offensive superiority or defensive capabilities in exchange for a promised, less tangible peace.

Still, disarmament's many proponents touch on important issues in making their arguments. They point to the expenditures necessary to fund research and production in a nuclear weapons program. They say that this money would be better used for education, housing, or health care. Second, the environmental costs, for the past, present, and future, are prohibitive. Testing has released radioactivity in the air over large portions of the western United States. Present-day medical research and nuclear fuel production present formidable problems for waste disposal. Waste products continue to accumulate as successive waste site proposals are delayed or denied. Finally, the moral issues surrounding the use, or threatened use, of nuclear weapons focus our attention on the death and destruction inflicted with one atomic bomb and the ethical limits of our actions toward others, even when we are at war.

Yet, over the past fifty years, much of our military doctrine in the United States and around the world has centered on nuclear weapons. Some declare that complete disarmament is impossible; the resulting anarchy would merely lead to a new phase of rearmament. Indeed there are difficulties in verifying that all parties are in compliance with a disarmament agreement, as well as psychological barriers to maintaining a state of relative vulnerability. Furthermore, to expect to put the "genie" of nuclear technology back in its bottle is considered unrealistic. Nuclear technology is something that will be with us into the foreseeable future and the best that we can hope is to bring it under rational control. Intermittent successes in arms control have addressed international trade in nuclear materials, testing of nuclear devices, and the quantity of nuclear weapons in the arsenals of various countries. In the latter case, treaties such as the SALT and START agreements have outlined concrete numerical reductions through the dismantling and destruction of specific classes of weapons. This moves in some way toward fulfilling responsibilities outlined in Article VI of the Nuclear Nonproliferation Treaty, the largest and longest-standing treaty on nuclear weapons.

activity six: "no one"

Despite these gains, there are many people and organizations worldwide still working for complete disarmament. Arguing that nuclear war simply is not possible without nuclear weapons, they hope to see the issue of disarmament return to the front burner.

Outline of Activity

Students read a fable written by Winston Churchill. They then examine a handbill for an anti-nuclear rally and the lyrics of a song by the music group "The Police." As a group, they create a fable that depicts their group's sentiments about the possibilities for global disarmament.

Extension Questions

1. How have "peace movements" affected the use and maintenance of atomic weapons programs so far?
2. Why are people motivated to keep their atomic weapons?
3. How do people's values and sense of morals affect their beliefs about nuclear weapons?

Related Issues

- Disarmament
- Role of international organizations like the UN in monitoring weapons dismantlement and destruction
- "Peace" movements
- Methods and rules of war
- Ethical issues regarding the use of atomic weaponry

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Waging Peace Bulletin. Santa Barbara, D.C.: The Nuclear Age Peace Foundation.

Endnote

[1]The Harvard Nuclear Study Group, Albert Carnesale et al, *Living with Nuclear Weapons*. New York: Bantam Books, 1983, p. 189.

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ACTIVITY CARD

As a group, examine the *Resource Cards* and discuss the questions below:

1. How does the group planning the demonstration in New York hope to influence the use of nuclear weapons?
2. What does Winston Churchill believe about the possibility of disarmament?
3. Why do some people believe that nuclear weapons should not be used at all?
4. How do you think those who believe we should destroy all nuclear weapons feel about other uses of nuclear technology for energy and medicine?
5. What would it take for the world to disarm itself? How do you evaluate the possibility that this could ever happen?

GROUP TASK

Your group should develop a fable that reflects your own analysis of the possibility and desirability for the world to disarm and destroy all of its nuclear weapons. Prepare to share your fable with the rest of the class.

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RESOURCE CARD (1 OF 3)
A FABLE

The Conference of the Animals

WINSTON CHURCHILL

Disarmament

Once upon a time all the animals in the zoos decided that they would disarm, and they arranged to have a conference to arrange the matter. So the Rhinoceros said when he opened the proceedings that the use of teeth was barbarous and horrible and ought to be strictly prohibited by general consent. Horns, which were mainly defensive weapons, would, of course, have to be allowed. The Buffalo, the Stag, the Porcupine, and even the little Hedgehog all said they would vote with the Rhino, but the Lion and the Tiger took a different view. They defended teeth and even claws, which they described as honourable weapons of immortal antiquity. The Panther, the Leopard, the Puma, and the whole tribe of small cats all supported the Lion and the Tiger. Then the Bear spoke. He proposed that both teeth and horns should be banned and never used again for fighting by any animal. It would be quite enough if animals were allowed to give each other a good hug when they quarrelled. No one could object to that. It was so fraternal, and that would be a great step towards peace. However, all the other animals were very offended with the Bear, and the Turkey fell into a perfect panic.

The discussion got so hot and angry, and all those animals began thinking so much about horns and teeth and hugging when they argued about the peaceful intentions that had brought them together that they began to look at one another in a very nasty way. Luckily the keepers were able to calm them down and persuade them to go back quietly to their cages, and they began to feel quite friendly with one another again.

Aldersbrook Road, West Essex, October 25, 1928

Czarnomski, ed., *The Eloquence of Churchill*

RESOURCE CARD (2 OF 3)
HANDBILL FOR A RALLY

A RALLY TO
STOP THE SPREAD OF WEAPONS
in our communities and around the world

SATURDAY, APRIL 22nd, 9:30 AM
DAG HAMMARSKJOLD PLAZA
47th Street and UN PLAZA (First Avenue)
New York City

SPEAKERS, ENTERTAINMENT (in formation)
VINIE BURROWS, Actress
The REVEREND WILLIAM SLOANE COFFIN
President Emeritus, National Peace Action
The REVEREND HERBERT DAUGHTRY, House of Lord, Bklyn.
DANIEL ELLSBERG, Former Pentagon Analyst
TINA JOHNSTONE, Founder, Silent Anti-Gun March
Prof. MICHIO KAKU, Nuclear Physicist, City Univ. New York
LAFAYETTE AVENUE INSPIRATIONAL ENSEMBLE
Dr. VICTOR W. SIDEL, Co-President, Nobel Prize-Winning International Physicians for Prevention of Nuclear War

- **DEMONSTRATE FOR THE END OF WEAPONS TRAFFICKING-AT HOME AND ABROAD**
- **DEMONSTRATE FOR A COMPREHENSIVE TEST BAN AND ELIMINATION OF ALL NUCLEAR WEAPONS**
- **DEMONSTRATE FOR THE TRANSFER OF MILITARY FUNDS TO JOBS, EDUCATION, HOUSING, HEALTH CARE**
- **DEMONSTRATE FOR AN ENVIRONMENT FREE FROM RADIOACTIVE AND TOXIC MILITARY POLLUTION**

JOIN US! BRING YOUR NEIGHBORS!

NPT Activist Kit, March 1995
California Peace Action

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RESOURCE CARD (3 OF 3)
ANTI-NUCLEAR MUSIC AND ART

"Walking in Your Footsteps"
(Words and music by Sting)

Fifty million years ago
You walked upon the planet so,
Lord of all that you could see
Just a little bit like me,

Walking in your footsteps.

Hey Mr. Dinosaur
you really couldn't ask for more
You were God's favourite creature
but you didn't have a future,
Walking in your footsteps.

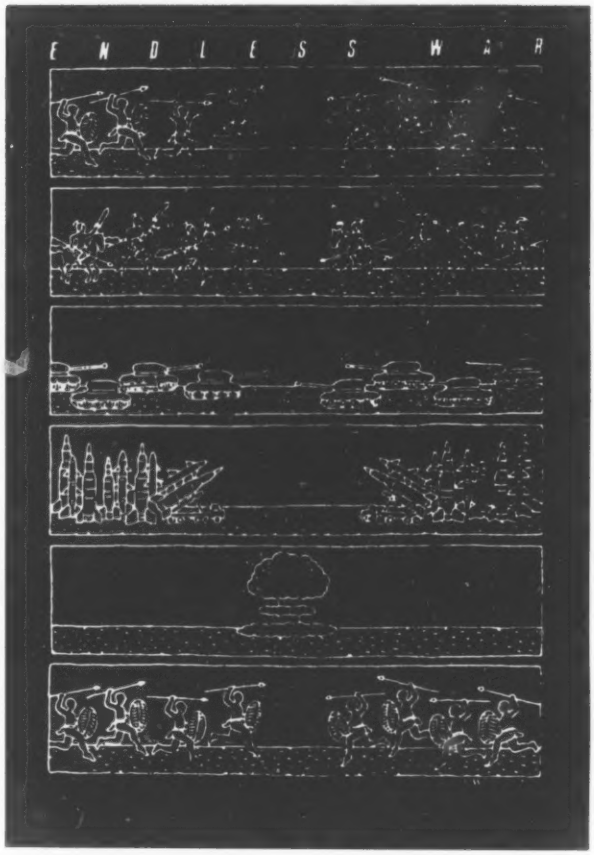
Hey mighty brontosaurus
don't you have a lesson for us?
You thought your rule would always last
There were no lessons in your past
You were built three stories high
They say you would not hurt a fly
If we explode the atom bomb
would they say that we were dumb?

Walking in your footsteps.

Fifty million years ago
They walked upon the planet so
They live in a museum
it's the only place you'll see 'um.

Walking in your footsteps.....
They say the meek shall inherit the earth.....
Walking in your footsteps.....

The Police, *Synchronicity*, EMI Music Publishers



Artist: Wangdon Lee,
Courtesy of *Graphis*

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INDIVIDUAL REPORT

Name:_____

What would be the consequences if uses of nuclear technology, both military and civilian, were abandoned?

Closing Activity

Nuclear Summit

Overview

In this activity, students will apply what they have learned about various options for controlling nuclear technology by developing policy recommendations for eight different countries. Students will then attempt to negotiate a treaty among the eight nations.

Objectives

- To provide students with an opportunity to synthesize and apply what they have learned about the issues in making policy about nuclear technology
- To develop student research skills
- To practice negotiation skills

Time

Three class periods

Materials

- Handout 1: Policy Research Task
- Handout 2: Treaty Conference Protocol

Suggested Procedure

DAYS ONE AND TWO

1. Divide students into eight groups. Tell them that each group will become the diplomatic staff of a country preparing to negotiate a treaty on the control of nuclear technology. They will have two days to prepare for the treaty conference. Distribute Handout 1: Policy Research Task to each group. Designate the countries as follows: Brazil, China, India, Iran, Japan, New Zealand, Russia, United States. You may wish to alter the countries if particular issues are in the current news or to align with other topics you are studying.
2. Allow student groups two days for research and development of policy recommendations. You may want to build in a structured visit to the library or time to access Internet resources. Each country will turn in a list of its policy recommendations at the end of the second day.

DAY THREE

3. Tell the students that it is time to prepare for the actual treaty conference. Ask students to describe some possible negotiating strategies that they have seen used in other settings. Ask them what

they learned from the Skill Builder Activity that they could apply to this new situation.

4. Allow students time to finalize preparations for their opening statements and to review their negotiating strategies. Allow 20 minutes for student groups to work together, then conduct the opening of the Treaty Conference. You should serve as moderator for the conference and call upon each delegation to introduce its members and to make its opening statement. Allow each group no more than 3 minutes for its statement and introductions.

DAY FOUR (AND OPTIONAL DAY FIVE)

5. Begin the Treaty Conference by allowing each country to put its proposals before the whole group. Once all countries have had an opportunity to speak, allow the groups to begin negotiating with each other. You should serve as moderator for the negotiations. Halfway through the class, take a 5-minute "break" to allow students to regroup with their own country or to try to make "behind the scenes" deals with other countries.
6. As moderator, at the conclusion of the negotiating time, summarize the status of the negotiations. If no agreement has been reached, take a vote to determine if the countries want to meet again in the future to continue talks. If an agreement has been reached, have all parties sign the agreement. Remind the students that in some cases, the delegates will need to have the treaty ratified by its own government before it can become a formal signatory to the agreement.
7. Debrief the Treaty Conference by asking students some of the following questions:
   - How are you feeling about the negotiations? (Ask each country.)
   - Describe what happened within your country as it prepared for the conference. Were these preparations adequate? What kind of information was most helpful? Were you ready to negotiate?
   - What happened when the negotiations began?
   - Did anything surprise you during the negotiations?
   - Did your country meet its objectives? Did your country's objectives change during the negotiations?
   - How did the size and wealth of countries affect their ability to influence others in the negotiations?
   - What negotiating tactics seemed most successful?
   - What are some of the issues that arise when you are trying to negotiate a common agreement among several countries?
   - How would you evaluate the outcome of the Treaty Conference?

© SPICE

POLICY RESEARCH TASK
HANDOUT (1 OF 2)

Your group is the negotiating team that will represent the country of _____ at an international conference set up to create agreements that will determine who can use nuclear technology and under what conditions. Assign the following roles to members of your group: Chief Negotiator, Assistant Negotiator, Research Staff Person, Press Secretary. Decide what responsibilities each of these members of your team will assume.

Before the conference, you will have time to do research on your country and identify what treaty agreements will best serve your country's interests. Some of the questions below may guide your research.

By the time the conference begins you will need to have developed specific recommendations for the treaty and be prepared to present your recommendations to the conference in a **1 minute opening statement** and a **3-minute proposal.** You may want to develop specific visual aids or other handouts for the other conference participants.

You will also need to develop a negotiating strategy to use during the conference.

Research Questions

- What are some of the basic statistics regarding our country? Size? Population? Gross National Product? Quality of life indicators (infant mortality, etc.)?
- What access to nuclear technology does our country currently have? If our country has nuclear technology, how is it used?
- What policies or goals regarding nuclear technology has our country developed? How does the general public in our country feel about nuclear technology?
- What are some of the serious issues facing our country today? How do they affect our nuclear strategy?
- Who are our country's principal trading partners? Who are our traditional allies in times of conflict?
- Is there anything our country can promise others in exchange for support on our proposed nuclear policies?
- Is there anything we need that we might be able to get from others for supporting their nuclear policies?
- How are decisions about international policies made in our country? Can we make decisions for our country, or will whatever we negotiate have to be approved by others?

TREATY CONFERENCE PROTOCOL
HANDOUT (2 OF 2)

All proceedings of the conference shall be in English.

Each negotiating team will be allowed a 1-minute opening statement during the Opening Session.

Each negotiating team will be allowed 3 minutes to put forward their country's proposal during the first formal session of the conference.

There will be at least one 5-minute break in the negotiating process to allow conference attendees to confer with their own team and informally with other negotiators.

All negotiators will refer to each other as "The Honorable (name)" before speaking to each other.

Only one person will be allowed to speak at one time and must be recognized by the Moderator before speaking.

If the conference reaches an agreement on treaty language during the conference, it will be put into written form and all parties must initial it before the end of the conference. Each country must also indicate how they will get formal support from their own country for the proposals when they return home.

If no treaty agreements are reached, the parties must take a vote to determine if they will meet again at a future date to continue the negotiations.

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ESTIMATED NUCLEAR STOCKPILES, 1945-1993

Year	U.S.	S.U./Russia	U.K.	France	China	Total
1945	2	0	0	0	0	2
1946	9	0	0	0	0	9
1947	13	0	0	0	0	13
1948	56	0	0	0	0	56
1949	169	1	0	0	0	170
1950	298	5	0	0	0	303
1951	438	25	0	0	0	463
1952	832	50	0	0	0	882
1953	1,161	120	1	0	0	1,282
1954	1,630	150	5	0	0	1,785
1955	2,280	200	10	0	0	2,490
1956	3,620	400	15	0	0	4,035
1957	5,828	650	20	0	0	6,498
1958	7,402	900	20	0	0	8,322
1959	12,305	1,050	25	0	0	13,380
1960	18,700	1,700	30	0	0	20,430
1961	23,200	2,450	50	0	0	25,700
1962	27,100	3,100	205	0	0	30,405
1963	29,800	4,000	280	0	0	34,080
1964	31,600	5,100	310	4	1	37,015
1965	32,400	6,300	310	35	5	39,050
1966	32,450	7,550	270	40	20	40,330
1967	32,500	8,850	270	40	25	41,685
1968	30,700	10,000	280	40	35	41,055
1969	28,200	11,000	310	40	50	39,600
1970	26,600	12,700	280	40	75	39,695
1971	26,500	14,500	220	45	100	41,365
1972	27,000	16,600	220	70	130	44,020
1973	28,400	18,800	275	120	150	47,745
1974	29,100	21,100	325	145	170	50,840
1975	28,100	23,500	350	190	185	52,325
1976	26,700	25,800	350	215	190	53,255
1977	25,800	28,400	350	230	200	54,980
1978	24,600	31,400	350	235	220	56,805
1979	24,300	34,000	350	235	235	59,120
1980	24,300	36,300	350	250	280	61,480
1981	23,400	38,700	350	275	330	63,055
1982	23,000	40,800	335	275	360	64,770
1983	23,400	42,600	320	280	380	66,980
1984	23,600	43,300	270	280	415	67,865
1985	23,500	44,000	300	360	430	68,590
1986	23,400	45,000	300	355	425	69,480
1987	23,700	44,000	300	420	415	68,835
1988	23,400	42,500	300	410	430	67,040
1989	22,500	40,000	300	415	435	63,650
1990	21,000	38,000	300	505	435	60,240
1991	19,500	35,000	300	540	435	55,775
1992	18,200	33,500	200	540	435	52,875
1993	16,750	32,000	200	525	435	49,910

The Bulletin of the Atomic Scientists (December 1993)

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A Nuclear Weapons Chronology

Date	Event
July 16, 1945	U.S. "Trinity" test, first atomic bomb explosion
August 6/9, 1945	Hiroshima and Nagasaki bombed
1949	U.S.S.R. atomic bomb
1952	U.K. atomic bomb
1960	French atomic bomb
1964	Chinese atomic bomb
1970?	Israeli atomic bomb
1974	Indian atomic bomb
1982	South Africa secretly develops atomic bomb, no explosion (voluntarily dismantles in 1991)
1989	Ukraine, Kazakhstan, and Belarus become "instant" nuclear powers
1990s	Iraq? North Korea? Japan?
1998	India, Pakistan explode nuclear devices

adapted from *Social Education* (March 1990)

TREATY TIMELINE

Date	Event
June 1946	Baruch Plan proposed (not completed)
December 1953	"Atoms for Peace" speech at U.N. by President Eisenhower
1957	International Atomic Energy Agency (IAEA) established
1959	Antarctic Treaty
1963	Limited Test Ban Treaty
1967	Outer Space Treaty; Treaty of Tlatelolco
1968	Nuclear Nonproliferation Treaty (NPT)
1972	Strategic Arms Limitation Talks (SALT) I
1974	Threshold Test Ban Treaty
1976	Peaceful Nuclear Explosions Treaty
1979	SALT II
1987	Intermediate-Range Nuclear Forces (INF) Treaty
1991	Strategic Arms Reduction Talks (START) I
1993	START II
1995	NPT indefinitely extended

THE INTERNATIONAL CONTROL REGIME

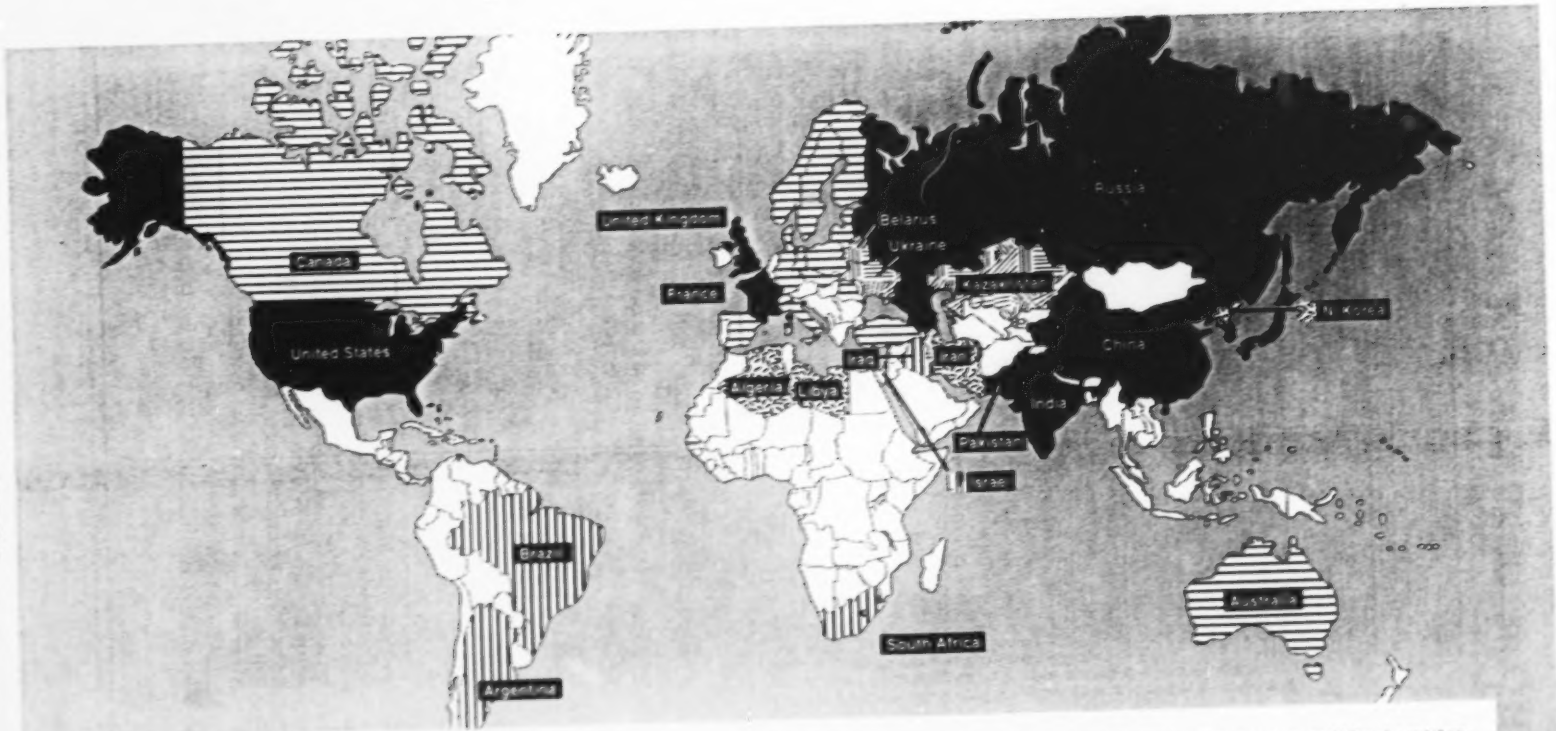
The International Atomic Energy Agency (IAEA)

Based in Vienna, Austria, the IAEA is a United Nations affiliate organization that was founded in 1957 and now has over 100 member-countries. The agency's key function is to conduct on-site inspections of nuclear installations around the globe to verify that nuclear materials are being used exclusively for peaceful energy and research and not for nuclear arms. Today the agency inspects more than 95 percent of all nuclear facilities outside of the five declared nuclear weapons states, auditing operation records and performing physical inventories of nuclear materials to make certain that none have been diverted for military purposes. Though not without their limitations, IAEA inspections are a critically important and widely accepted means for countries to give assurance that they are not misusing inspected installations.

The Nuclear Non-Proliferation Treaty (NPT)

This treaty, the second key part of the non-proliferation regime, was signed in 1968 and went into effect in 1970. More than 170 non-nuclear-weapon countries are now parties to the pact. Under the treaty, these parties pledge not to manufacture or acquire nuclear weapons and have agreed to place *all* of their nuclear plants under IAEA inspection, effectively ruling out the use of any part of their nuclear program for nuclear arms. In return for this, the nuclear-weapon states that sponsored the accord—the United States, Soviet Union, and Great Britain—are required to negotiate in good faith to end the nuclear arms race and (along with other advanced countries) to assist other parties in peaceful nuclear projects. To ensure that nuclear sales do not contribute to weapons programs, all parties are also required to make sure that the recipient of any export places it under IAEA safeguards.

Social Education (March 1990)



Declared Nuclear Weapon States

Newly Independent States with Nuclear Weapons on Territory: Belarus, Kazakhstan, and Ukraine have acceded to the NPT as non-nuclear weapon states. All are transfering nuclear weapons to Russia.

Undeclared Nuclear Weapons States: These nations are believed to be able to deploy one or more nuclear weapons rapidly or to have deployed them already.

Active/Suspected Nuclear Weapons Programs: North Korea, Iran, and Libya have taken steps in the past several years to acquire nuclear weapons capabilities. Algeria may also have done so.

Recent Renunciations: These nations were known or believed to have had active nuclear-weapons programs during the 1980s, but recently renounced such activities by opening all of their nuclear facilities to international inspection and/or by ceasing clandestine research on nuclear arms. Iraq's program was dismantled by U.N. inspectors after Iraq's defeat in the Gulf War and is under special U.N. mandated long-term monitoring.

Abstaining Countries: These countries have the technological base, but not thus far the desire, to develop nuclear weapons. A number have installations under international inspection that can produce weapons-grade nuclear material.

Based on map, "The Spread of Nuclear Weapons: 1945 to the Present," by Carnegie Endowment for International Peace
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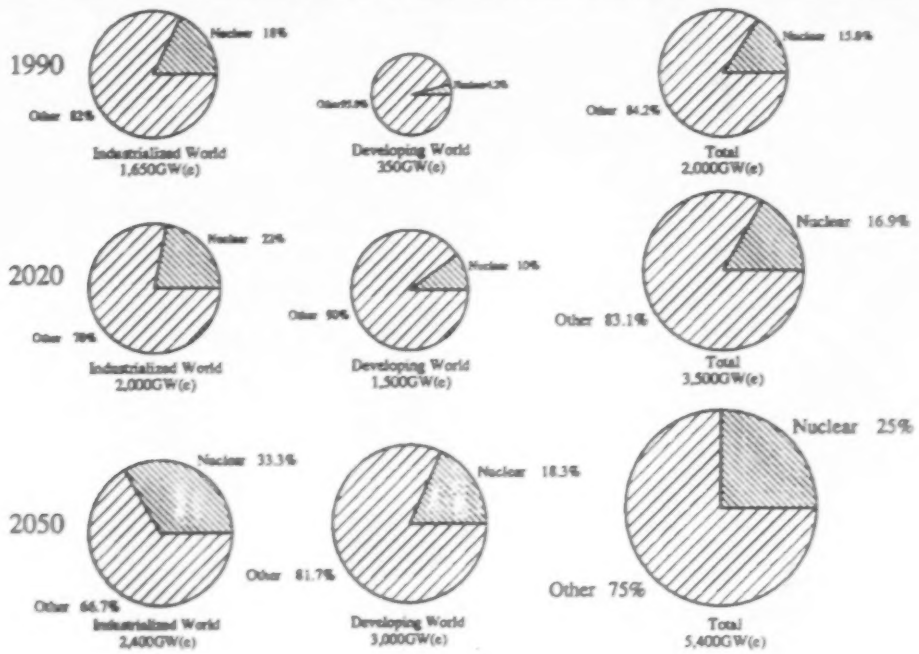
Nuclear Energy Around the World, 1990-2050

World Generating Capacity, GWe, and percentage nuclear share of capacity



Source: Estimated by author and based on demand estimates of Table 7.1.

Beck, *Prospects and Strategies for Nuclear Power*

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